Lessons Learned from Applying Human Computer Interaction (HCI) Techniques to the Redesign of a User Interface

by

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Dissertation submitted in partial fulfillment of

the requirements for the

Bachelor of Technology (Hons)

(Information Systems)

June 2004

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1. Human - computer
   interaction
2. IT/IS —thesis

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CERTIFICATION OF APPROVAL

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A project dissertation submitted to the
Information System Programme
Universiti Teknologi PETRONAS
in partial fulfillment of the requirement for the
BACHELOR OF TECHNOLOGY (Hons)
(INFORMATION SYSTEMS)

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

KAREN LEE CHOY YIN

ABSTRACT

This research details the finding on web page design principles focusing on the Human Computer Interaction (HCI) aspect. The focus was derived from the Top Ten (10) Web Page Design Mistakes (2003) by Jakob Nielsen, a well-known guru of HCI and usability. In this technological era, there are thousands and millions of web sites and pages but how many of these pages are properly designed? Web page designers nowadays focus too much on the functionality of a system instead interface design which actually projects an application's uniqueness and key messages that creates the desired emotional response from the users involved The objectives of this research includes investigation of principles applied in HCI for web page interface design, redefinition of the erroneous web pages and formulation of domain-specific rules to ensure the effectiveness, practicality and acceptance of these techniques. Usability lab testing, questionnaires, prototype screens are done to focus on evaluation, based on the usability criteria of web pages identified from many credible sources. This research was done based on the fact that Internet users' preference and ease of browsing plays a vital role in deciding the acceptance of a web page. A powerful system would be left behind by users if it is not user friendly or designed according to the standards, principles and guidelines of HCI. The methodology used concentrates on a problem-specified framework which was developed by the author. There were six (6) processes involved namely Identification of target users, User consultation, Task analysis, Usability and accessibility assurance, Consideration of web design issues and Formulation of user interface design specification. The final result of this study is a domain specific guideline of HCI for web page design customized for profit making organizations and individuals. In conclusion, HCI principles is inseparable when it comes to web designing issues and this will continue to be vital as long as web page exist and is used by many.

ACKNOWLEDGEMENTS

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ABBREVIATIONS AND NOMENCLATURES

The following are general abbreviations and nomenclatures used throughout this dissertation.

HCI	Human Computer Interaction
UI	User Interface
UE	Usability Engineering
UC	User Centered
GUI	Graphical User Interface
IT	Information Technology
IS	Information Systems
UTP	Universiti Teknologi PETRONAS
URL	Uniform Resource Locator
ALT	Alternative
IE	Internet Explorer
DSL	Digital Subscriber Line

CHAPTER 1

INTRODUCTION

1. INTRODUCTION

All Internet Users have to interact with many different User Interfaces (UIs) everyday. We rely heavily on the usage of Internet since the marking of the technological era symbolizing a borderless and paperless world that all country worldwide is aiming to achieve. Martin Belcher, Phil Cross (2000) highlighted the importance of good UIs by saying good Web page design can significantly increase the ease with which users can complete tasks, i.e. it increases usability. Many technological innovations rely upon UI design to elevate their technical complexity to a usable product.Since it is an inseparable element from our everyday life nowadays, we have to concentrate even more on the important issues affecting UIs.

When discussing about UIs, Human Computer Interaction (HCI) is the key source which covers detailed studies concerning UIs. Hewett, Baecker, Card, Carey, Gasen, Mantei, Perlman, Strong and Verplank (1996) define HCI as a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them (p.5).

HCI in the large is an interdisciplinary area. It covers diciplines of computer science (application design and engineering of human interfaces), psychology (the application of theories of cognitive processes and the empirical analysis of user behavior), sociology and anthropology (interactions between technology, work, and organization),

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and industrial design (interactive products). Please refer to the following figure for a clearer view of disciplines areas covered in HCI.

However, the focus of this project will cover issues within the computer science area. It is a known fact that the importance of good UI design can be the differentiating factor whether a particular web page is accepted or rejected in the marketplace. If end-users feel it is not easy to learn, not easy to use, or too cumbersome, an otherwise excellent product could fail.

Good UI design can make a a web application easy to understand and use, which results in greater user acceptance. Therefore, there arise a need for a set of complete HCI oriented techniques for the design of well accepted UIs.
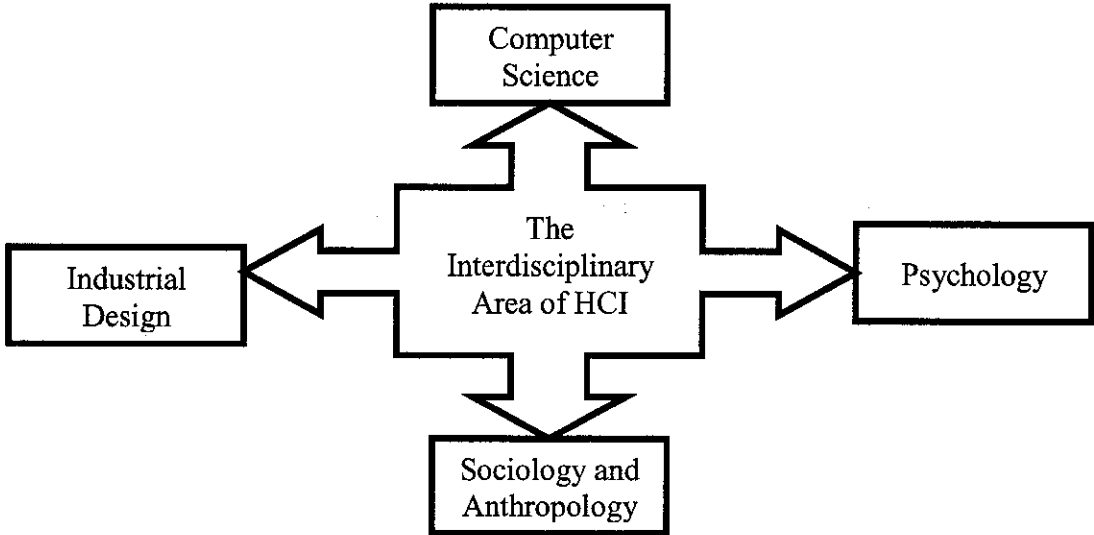
Figure 1.1 Areas of Specialty Covered in HCI

(Adapted from Hewett, Baecker, Card, Carey, Gasen, Mantei, Perlman, Strong and Verplank, 1996)

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1.1. Background of Study

Most of the time, IT (Information Technology) experts and professionals pay a lot of attention about the importance of usability and application development which are key components of any web applications. However, it is the interface design that projects the applications uniqueness and key messages that creates the desired emotional response from the users involved. John Meech (2003) in his workshop highlighted that the speed of performing a task (when interacting with the World Wide Web) has become less important; the enjoyment, satisfaction and fulfillment more so. From the above statement we can understand that the importance of good UIs is actually more important than the technical functionality of a web page.

Poor interface design damages user confidence in an application and by association the organizations or owner the application represents. This can result in the loss of leads or even users' confidence through the application. Good interface design reinforces brand values and creates customer trust. This is especially true on the web where users only have the appearance of the application and its content as a basis to judge whether an organization or the owner is reputable or not. Richard F. Dillon (2002) reinforces this fact with this statement that good UIs bring people back to your website.

There are many standards, rules, techniques, principles highlighted by reputable authors and IT practitioners but how do we determine which of these techniques are truly useful and essential in all web pages and applications design? This project will highlight the fundamental techniques which all IT people and organizations will agree on and summarize only the most practical and feasible techniques for future references and usage while designing UIs.

1.2. Problem Statement

1.2.1. Problem Identification

Current computer users are too comfortable with easy-to-use UI. From numerous observations, many useful systems still suffers from poor UI design. Web pages, sites, applications, programs and even systems will be placed behind and rejected by users if the UI were not designed according to the standards, principles and guidelines of HCI. A powerful system with poor UI design will be considered as a "bad" design in general and will be rejected by users. Richard F. Dillon (2002) supported this fact by saying poor UIs can cripple a system that is outstanding in all other respects (by having poor UIs).

Development of web pages, sites, applications and systems nowadays concentrates too much on the functionality and UI design issues are so often neglected. Most IT programmers hate UI design because they are mostly analytical, logical thinkers who are good at reasoning but poor in artistic judgment. This has greatly contributed to the alarming rise in poor UI design found in today's computer applications.

From numerous observations, the author had managed to repeatedly highlight ten (10) web-based UI design mistakes which are repeatedly done by UIs designers. All mistakes noted are taken from the article entitled The Top Ten (10) Web Design Mistakes of 2003 by Jakob Nielsen (2003). Nielsen is the principal of Nielsen Norman Group and noted as "the world's leading expert on web usability" by U.S. News and World Report and "the next best thing to a true time machine" by USA Today. He is also the author of the best-selling book Designing Web Usability: The Practice of Simplicity (2000), which has sold

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more than a quarter of a million copies in 22 languages. This source that the author is quoting is truly recognized by all UI personnel.

a. Unclear statement of purpose.

Many web pages do not let user know their main aim of having the particular page and users would have to browse through unnecessary information which is a waste of time.

b. New Uniform Resource Locators (URLs) for archived content.

Some old information is sent into the archive and only given URL from the main area resulting perception of unimportant facts is usually stored in the archive.

c. Undated content.

Without dates on articles, press releases, and other content, users have no idea whether the information is current or obsolete.

d. Small thumbnail images of big, detailed photos.

It is a good way to reduce downloading time and users will have the option whether to view the enlarged picture or not but if an original photo has a lot of intricate detail, the thumbnail is often incomprehensible. This will mislead users.

e. Overly detailed Alternative (ALT) text.

Some web pages do consider people who are unable to see picture clearly and are replacing many pictures with ALT text. This is very not user-friendly to the rest.

f. No "What-If" support.

Many web pages are giving raw materials to users and do not consider assisting users who has needs of comparing facts and figures. Users tend to leave out pages which are "not helpful" when making decisions.

g. Long lists that cannot be winnowed by attributes.

There are many web pages out there which list out all their products without categorizing them. Users are usually irritated when they need to go through thousand of words just to find one keyword.

h. Products sorted only by brand.

Websites which represent business entities should have the sorting option which provides users the option to sort their product of interest by some different category. This will help users to browse more effectively.

i. Overly restrictive form entry.

Many online forms within web pages require information to be keyed-in by user in very restricted forms. Users need to trial-and-error when filling-up forms which are promote resistance.

j. Pages that link to themselves.

This scenario can be very irritating and cause confusions to interested users.

1.2.2. Significance of Project

There is actually a rational way to think about UI with some simple, logical rules that we now can apply anywhere to improve the interfaces of computer

applications. UI design is in reality extremely easy because UI designers usually don't need algorithms to adhere and followed strictly. It is straightforward because when any mistake is made during UI design, immediately error can be seen and correction can be done instantly. The results are immediately direct.

Web pages and applications are being developed everyday and the number is growing rapidly day after day. It is extremely important for these UIs to be properly designed and standardized to avoid continuous deterioration of UIs design quality. All end users of these applications will suffer at the end of the day if this alarming problem is not addressed immediately.

1.3. Objectives

The aim of this project is to redesign and develop a refined version of the web page(s) under study; to replace and take over the functions of the problematic page(s) identified at the beginning of the course with non-erroneous, user friendly page(s) for computer users' pleasure of internet surfing. Some supporting objectives are: -

a. To investigate the principles applied in HCI for web page interface design, compare and contrast different selected sources of HCI design standards and highlight UI design mistakes.

b. To avoid the identified erroneous interfaces and demonstrate a successful web site through applications of the ground rules in HCI.

c. To compare and summarize the domain-specific rules for web page design in order to prove the effectiveness, practicality and acceptance of these rules.

1.4. Scope of Project

1.4.1 Relevancy of Project – Scope of Work

This project will cover detailed and thorough research of HCI principles, techniques, standards and ground rules which are the subject under study by renowned HCI experts and specific organizations. This project does not only focus on research but also aim to redesign and refined problematic UIs with some real hands-on designing of "flawless" web pages. This is to further compare and contrast the before and after effects of considering HCI techniques in UIs designing.

HCI issues are becoming more and more important to designers nowadays. The perfect illustration of the importance of good UI design in a web page is demonstrated in a research paper by Susan Kaltenbach (2002) entitled Moving towards a new methodology: The retirement of the "Web site heuristic evaluation".

In the mentioned paper, Susan had made a convincing argument to throw away the non-empirical web site heuristics and replacing them with a new, non-prescriptive set of guideline. The author had adopted her research ideas from this paper.

Great detail of Usability Engineering (UE) design processes will be involved in the production of some new UI designs. Prototypes of web pages will be developed from time to time and tested out by real user groups differentiating in level of computer literacy. For the design of prototype, the User Centered (UC)

engineering approach will be adopted and shall be discussed in detail in Chapter 3.

Optimized UI design requires a systematic approach to the design process. But to ensure optimum performance, usability testing is required. Tests and observations will be seen completed with the usage of usability labs for close monitoring purpose. More attention will be focused on designing good UIs and collection of users' interactions and feedback when using the new pages designed. These practical testings permit even beginners users to provide feedback about what does work as anticipated and what does not work for a web page after going through specific tests. Types of tests and walk-through will be discussed further in Chapter 3.

Only after the resulting repairs are made can a web page be deemed to have a user optimized interface. The results will be demonstrated in Chapter 4 comparing and contrasting the usability of web pages before and after the amendments made.

1.5. Feasibility of Project

1.5.1. Technical Feasibility

The project scope and complexity is within the technical capacity and capability of the author. Therefore it is feasible to proceed with the specified scope and course especially with the help and assistance of supporting academicians and concerned technical personnel. The final product of this system is able to speed up design of UIs for future web pages. It will be guaranteed full-functional, practical set of guidelines to refer to while designing web pages.

1.5.2. Operational Feasibility

With the appropriate analyses and usage of advance tools and technologies, the final product and supporting documentation will be useful for many upcoming design works of web applications. It will be a complete documentation of useful and practical HCI techniques to be adopted by professionals, academicians, students who are in the IT industry. This will solve many dilemmas as faced by current UIs designers and programmers. Examples of good UI designs in web page will be demonstrated in the refined versions for better representation and applications of the identified techniques.

1.5.3. Economic Feasibility

The suggested standards and examples of good UI designs using ground rules of HCI will help to eliminate many tedious dilemma and incomplete prescription faced by many IT personnel nowadays. HCI techniques which are clearly defined will be highlighted and this will reduce workload of future UI designers tremendously. Many more economical illustrations will be seen in Chapter 4 highlighting tremendous cost reductions in web page designing after applying the identified techniques.

1.5.4. Schedule Feasibility

The total time allocated for this project is around four (4) months and is very reasonable for the completion of this project. The project schedule plan is further broken-down to achievable stages. As this project is done within the compound of this campus, the productions costs will be all subsidized and keep at a minimum value.

CHAPTER 2

LITERATURE REVIEW

2. LITERATURE REVIEW

2.1 Facts on Human Computer Interaction (HCI) Researches

Brad A. Myers had managed to support the author's research work by quoting the following statement when referring to his work entitled "A Brief History of Human Computer Interaction Technology":-

> "A motivation for this article is to overcome the mistaken impression that much of the important work in Human-Computer Interaction occurred in industry, and if university research in Human-Computer Interaction is not supported, then industry will just carry on anyway. This is simply not true. This paper tries to show that many of the most famous HCI successes developed by companies are deeply rooted in university research."

From Myers quotation, we could understand the importance and the relevancy of Human Computer Interaction (HCI) issues in today's electronic world. As computer gets faster and the evolvement of new technologies happens almost everyday, it is important for us to understand how we as users could understand and manipulate this machine. He mentioned that: -

> ".... virtually all software written today employs user interface toolkits and interface builders, concepts which were developed first at universities. Even the

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spectacular growth of the World-Wide Web is a direct result of HCI research: applying hypertext technology to browsers allows one to traverse a link across the world with a click of the mouse. Interface improvements more than anything else has triggered this explosive growth."

The above statements further strengthen the total concept of this research which is to contribute to the improvement, advancement of the HCI field specializing in the area of User Interface (UI). We as Internet users interact so much with the computer through UI. Therefore, it is extremely important to have good user interfaces to help us get our work done efficiently and effectively.

Terry Mullin (2002) shares the same point of view that HCI is crucial in UI by redefining the concerns of HCI: -

"The discipline (referring to HCI) is concerned with the capturing of information on such factors as ease of use, safety, usability by the end user, efficiency of use by the human element, the ability to understand without great detail the interface design, and the actual design of interfaces."

Poorly designed UI is equivalent to lost dollars for businesses due to factors such as inefficiency, human error, and retraining. By simply applying concepts of HCI, we can greatly reduce the risk of a failed UI design for web pages.

2.2   The Internet and Web Pages

The usage of Internet has increased tremendously and we can now witness its advantages resulting from its advancement in all industries including military, academia, business, computers and etc. Its users nowadays make it a ubiquitous tool for

information searching, learning, purchases, banking transactions and even entertainment. According to Vinton G. Cerf (2003):-

> "The Internet has revolutionized the computer and communications world like nothing before. The Internet is at once a world-wide broadcasting capability, a mechanism for information dissemination, and a medium for collaboration and interaction between individuals and their computers without regard for geographic location."

Web pages too have now become more complex and sophisticated. Users are expecting more out of User Interface (UI) but designers on the other hand sometimes failed to see its importance. There are so many available web page authoring tools and almost any Tom, Dick and Harry can create their own pages. This phenomenon has jeopardized the quality and standards of UI.

2.3   Importance of User Interface (UI) in Human Computer Interaction (HCI)

User Interface (UI) is important. Web page users do not read manuals but instead interacts directly with the page. This made UI sounded even more crucial then ever. Internet is known as a powerful tool nowadays. Both positive and negative extremes can just happen with just a little misrepresentation and misinterpretations through web pages.

User interfaces were designed to give people control over their personal computers and tasks they would like to perform. Users nowadays expect a level of design sophistication from all UI, including web pages. Human Computer Interaction (HCI) covers many disciplines. Hewett, Baecker, Card, Carey, Gasen, Mantei, Perlman, Strong and Verplank (1996) explain how UI design branches out from HCI: -

"Human-computer interaction is concerned with the joint performance of tasks by humans and machines; the structure of communication between human and machine; human capabilities to use machines (including the learn-ability of interfaces); algorithms and programming of the interface itself; engineering concerns that arise in designing and building interfaces; the process of specification, design, and implementation of interfaces; and design trade-offs. Human-computer interaction thus has science, engineering, and design aspects."

Experts recognize that UI design issues are becoming an important concern of HCI. Brad A. Myers also recognizes this fact by saying: -

"Another important argument in favor of HCI research in universities is that computer science students need to know about user interface issues. User interfaces are likely to be one of the main value-added competitive advantages of the future, as both hardware and basic software become commodities. If students do not know about user interfaces, they will not serve industry needs. It seems that only through computer science does HCI research disseminate out into products."

The following is a cardinal axiom by Joel Spolsky (2001) concerning UI design for HCI people.

"To make people happy, you have to let them feel like they are in control of their environment. To do this, you need to correctly interpret their actions. The interface needs to behave in the way they are expecting it to behave."

UI is important because it affects the feelings, emotions, and mood of users. If the UI is wrong and the user feels like they are out of control, they would not be happy and will

blame it on the ineffectiveness of the web page. If the UI is smartly designed and things work the way the user expected them to work, they will be cheerful as they manage to accomplish small goals.

2.4   The Increasing Importance of Good User Interface (UI) Design in Web Pages

Usability is critical to all business related web pages. The author once heard someone said that a web page owned by a business is like a full time "salesperson" working round the clock and has always imagine that the UI of the page signifies the outer, physical appearance of the "salesperson". The better the UI is designed; the users of the page will prefer it more just like how we human are drawn to attractive salesperson before even looking at the product they offer. UI is the total packaging of a web page.

John Meech (2004) is Senior User Interface Designer, in a large IT corporation - AmikaNow! In his CITO/OCRI TechTalk Workshop on User Interface Technologies, he explained that: -

> "User interface design and evaluation originally centered on performance issues and concentrated on objective measures of system effectiveness. Although these aspects of design and usability analysis are still important, the advent of the World-Wide-Web (and the increase in available bandwidth) together with a proliferation of handheld computing and communications devices has resulted in the user experience becoming an increasingly important factor in making a product or service successful."

Internet or web pages users now are seen to concentrate more on the subjective experience of interacting with a web site, mobile device, or communications system. This interaction has become the deciding factor for users who are able to choose which

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of several competing systems they would like to employ. The enjoyment, satisfaction and fulfillment of interacting with good UI have change in emphasis and are affecting the design and evaluation practices in interface and interaction design.

Martin Belcher and Phil Cross (2000) signify the importance of good UI design by saying that the web page which is good need to be usable, the design employed need to be informational and is able to significantly ease users to complete their tasks. Designers and developers should know that users who cannot complete their tasks are frustrated users and frustrated users don't come back to a particular web page. On the other hand, users who are able to complete their tasks are happy users and will definitely come back to a web page and often tell their friends and colleagues about a great site or page. Good web page is able to attract returning users and spread its name by word of mouth.

Value added web pages and sites are sometimes referred to as informational gateway. UI is the only way a user can interact with a system, application, web site or page. It is what the user sees. If what they see is hard to understand or difficult to use, then the vast majority of users will never make it to the real content or value-added features of the web page according to Martin Belcher and Phil Cross (2000).

2.5 The Downside of Poor User Interface (UI)

Poor user interface design can hide even the most powerful and useful web page from all users. Web developers have to consider seriously the issues of user interface design and implementation. A poor user interface will mean low usage of the page and ultimate failure. The failure of web pages is often due to their designers' not considering their users and designing with the assumption of too much technical knowledge themselves.

Brad A. Myers (1999) points out that it is very non-feasible and expensive by not considering well-defined techniques and methodology while designing UI. This is because recovery, corrections and redesigning will consumed lots of money and effort when a page is operational.

Many web designers actually missed out considerations of HCI techniques during designing is because they do not think from the users' perspectives and regard UI design as being a non-technical function thus paying any or much attention on it.

Martin Belcher and Phil Cross (2000) are very definite is saying: -

> "Generally we don't notice interface design unless there is a problem, resulting either from poor design or from our attempting to use an object for something other than the purpose for which it was designed."

Software design and development has been around for a short period of time, and it is even less for web page design. Most of the time, the usability of computer systems and web pages is not completely understood or recognized. Ian Sommerville (2000), a famous author in Software Engineering agrees as well that a poorly designed interface can cause users to make catastrophic errors and most often that than not, poor user interface is the main reason why many system has not been used.

Usually, when a new user sits down browse a web page, they do not come with a completely clean slate. They have some expectations of how they think the page or the UI is going to work for them. This is called the user model or mental understanding of how the UI is going to behave. This research has an aim or producing an example which match the final UI with the mental model of prospect users.

No party should ever neglect HCI considerations when designing web pages for profit-making organizations or businesses, ever.

2.6   Supporting Facts on User Interface (UI) Design Techniques

The author had managed to compare the identified User interface (UI) design principles for general profit-making organizations' and individuals' web pages designs with the following attributes highlighted by Jacob Nielsen (2000) for all general system design. The usability attributes adopted as supporting facts are: -

a. Learn-ability

This will look into how long does it take a new user to use the system without much help provided and be productive with the system.

b. Speed of operation

This will examine on how well a particular task can be accomplished with the system response matching the user's work practice.

c. Robustness

The observation on tolerance and leniency of the system to recover from user errors will prove a web page's robustness.

d. Recoverability

Recoverability of a system will inspect how good the application in a web site recovers from errors done by the users.

e. Adaptability

This will study how closely the system is tied down to a single model of work. Is the web page flexible and compliant to users' tasks being performed on it?

CHAPTER 3

METHODOLOGY

3. METHODOLOGY

In order to redesign the prototype screens with considerations of good HCI principles, the author needs to go through the following six (6) procedures to complete the process. Summarized in a framework it will appear to be as follows: -

Identifying Target Users	=	- Conduct background survey. - Obtain users' agreement.
User Consultation	=	- Target users list and prioritize their needs. - Identify current web usage and preferences.
Task Analysis	=	- Observation on users tasks, goals and problems thus suggesting solutions.
Ensuring Usability and Accessibility	=	- Adoption of chosen techniques for evaluation done by users as feedback.
Consideration of Web Design Issues	=	- Compare and contrast design principles from various sources and screen through.
Developing a User Interface Design Specification	=	- Summarize a finalize set of techniques for web page design.

Figure 3.1   Methodology Frameworks Used

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a. Identifying target users.

When identifying target users, it is important to ask this question i.e. who are the potential users of the web page which is currently under development. It has been identified that the users can be any Internet users because the web pages under study are those owned by profit-making organizations and individuals. The subjects chosen are a group of undergraduates from Universiti Teknologi PETRONAS (UTP).

b. User consultation.

By asking users about their wants, needs, likes and dislikes, it will offer an initial, proper framework on how to continue designing the web page. Target users were asked to prioritize their needs for effective web page browsing and accomplishing their tasks. Users also looked into how they would like web pages to be designed for their comfort.

c. Task analysis.

Users' preference, needs, goals and tasks, the strategies they use to perform the tasks, the web pages they frequently visit, problems they experience, and the changes they would like to see were obtained. When designing, it is crucial to be able to visualize and anticipate what kind of tasks these identified users are going to carry out using or browsing a web page.

d. Ensuring usability and accessibility.

Good web page design examples are presented to users for more feedback and responses. User appeared to accept and support all the good practices highlighted. Web pages need to be usable and good web page design can significantly increase the ease with which users can complete tasks, i.e. it increases usability directly.

e. Consideration of web design issues.

Always take into considerations some up-coming and arising issues in the web design field. It is also always appropriate to compare and contrast some useful, practical principles and techniques applied by other organizations and IT practitioners. When choosing the web pages for evaluation purposes, it was ensured that the web pages are able to demonstrate the effectiveness and benefits of good design practices.

f. Developing a user interface design specification.

When all the above mentioned steps are carried out, one process and findings was documented in a clear and concise manner. The author did summarize a set of User Interface (UI) designing techniques and these shall be discussed in detailed in Chapter 4.

The only way a user can interact with even the most advanced web site is via User Interface. UI is simply what the user sees on the screen through their browser. If what they see is hard to understand or difficult to use, then the vast majority of users will never make it to the real content or value-added features of a web site. Therefore, UI design with the considerations of Human Computer Interaction (HCI) techniques is crucial for all web page design. It is even more vital for profit-making web pages own by organizations and individuals.

3.1.   Identifying Target Users

The target users of this study are all Internet users who interact with business web pages. However, this was scoped down to a group of undergraduate from Universiti Teknologi PETRONAS (UTP). The number of test subjects is ten (10). This is because according to the following chart, five (5) users are sufficient for any type of average

usability test. According to the curve indicated, after a testing run on five (5) test subjects, 85% of the complete testing result can be obtained. The other 15% can be reserved for a second round of testing after some redesign in the later stages. This result is taken from the work of Jakob Nielsen and Tom Landauer entitled "A mathematical model of the finding of usability problems" (2000).
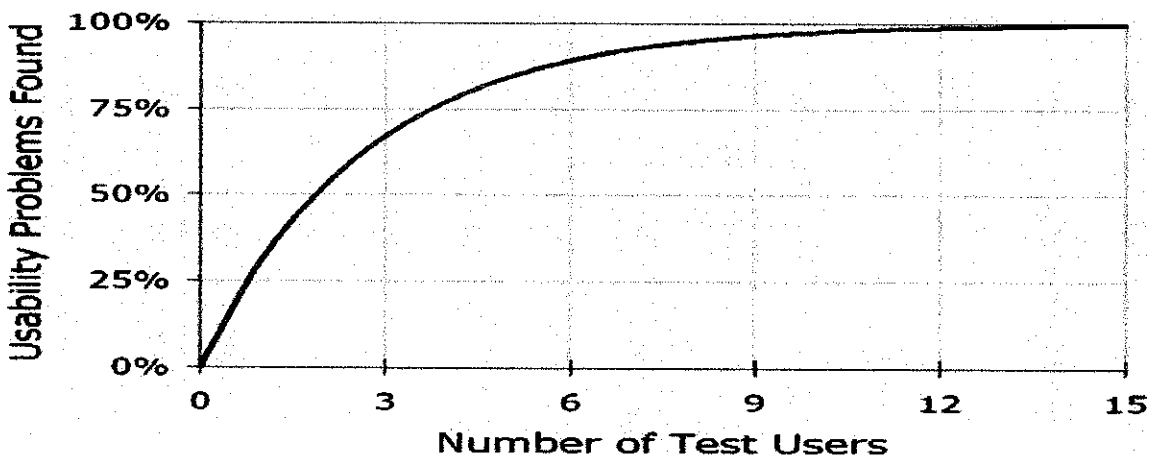
Figure 3.2 Graph Indicating Feasible Number of Test Subjects for Usability Testing

3.1.1 Observations of Human – Web Pages Interaction Patterns

The author's has to research on the needs and preferences of the target audiences because this information is crucial. It's impossible to design for an unknown person whose needs we ourselves do not understand. Hence, the prototype screens were adopted based on the needs of the target users and the main purpose of the web pages.

The author used the checklist method to observe and focus on how Internet users seek information and interact with web pages. This observation allows understanding of the crucial elements when designing web pages to be gathered.

3.2   User Consultation

User consultation involves meeting and working with the web page target users to obtain requirement of the users directly face-to-face. To identify the suitable web pages screens for comparison which will suit the users' requirements and preferences, the author had adopted a prototyping tool for this process called the "Post-it Prototyping". This method involves the following processes: -

1. Internet Explorer (IE) browser is printed on plain paper and copies of this are made by the author.
2. Users are required to draft the overall appearance of the web page. This includes objects and texts that they would like to have on an ideal web page.
3. As this process continued, changes are being made. The changes are documented using Post-it and stacked on top on the initial design to track the changes.
4. This continued until the desired web page design is achieved.

This particular method is chosen because: -

a.   Users get a good idea of the future web page developed.

Rough sketches made of pieces of paper are appealing to users as they get a good image of the web application. Their comments improved the quality of the design.

b.   Fast and easy changes can be made.

Users get enthusiastic when they see their comments incorporated quickly. Assume that the very first design is not yet perfect; the author is able to make an improved version in just a couple of minutes. Usually iterations ranging from three (3) to five (5) times is sufficient to enhance the design because small steps will eventually to perfection.

c.   Users feel free to comment on the design.

The process of sketching will promote responses from users that make this method of designing so effective. Complicated, technical schemas remain completely out of sight. Users see that the sketch as some draft still far away from a final design and this removes a psychological threshold. They realized that their opinions affect the design and that the author has an open mind for their comments.

User requirements gathering is vital and the method adopted in this process is justified to be effective because if users are only shown the design by the author, they will perceive the design as complete and their feedback no longer be valuable or will have any effect on the web page design. A graphical example of a draft adopting the "Post-it Prototyping" is illustrated as follow: -
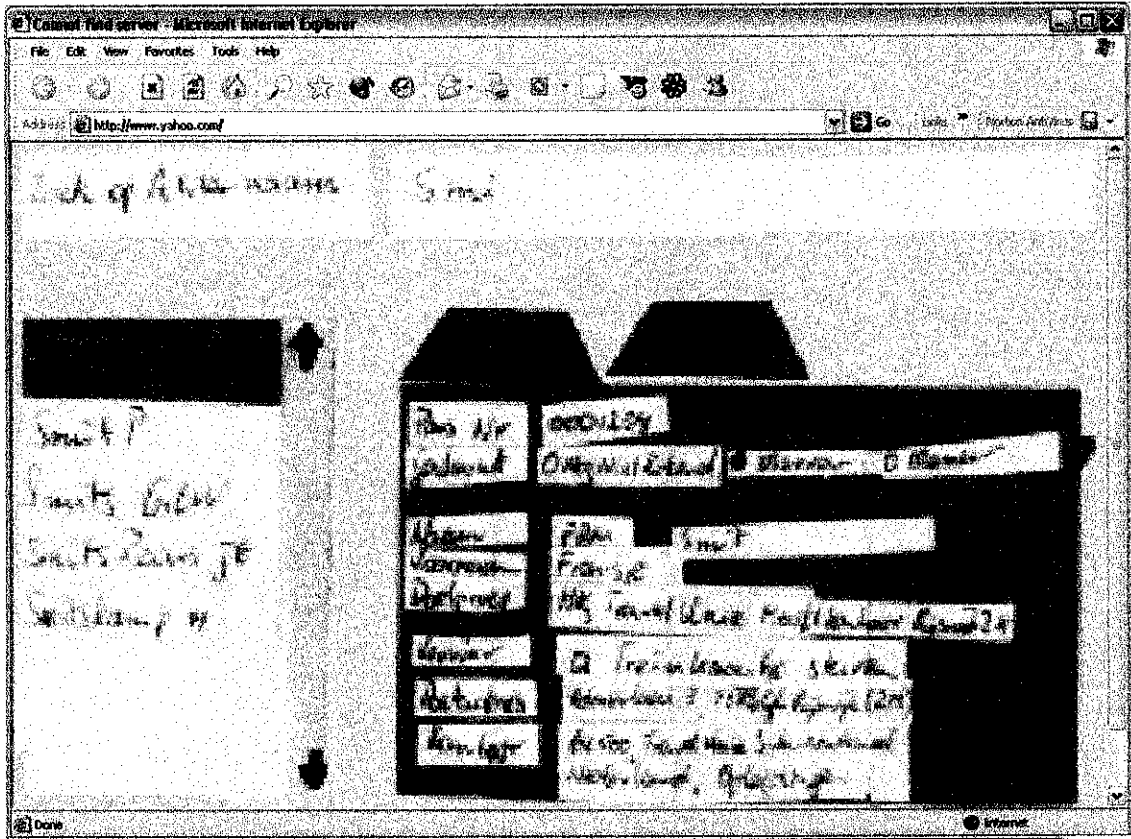
Figure 3.3   Post-it Prototyping Draft

3.3   Task Analysis

Task analysis looks into what a web page user is required to do in terms of actions and cognitive processes to complete their tasks. A detailed task analysis had been conducted to understand the information which goes through web pages. These information flows are important for future maintenance and improvements. Task analysis made it possible to design and allocate tasks appropriately for the design process. The task analysis conducted actually accurately analyzes the functions to be included within the web page and the most appropriate user interfaces.

It is a must for all we page development to conduct tasks analysis to provide knowledge of the tasks that the user wishes to perform for the consideration of the author. Thus it is a great reference for all who are involved. To make tasks analysis possible, the author had adopted the task decomposition method or breaking down the final, major task into achievable and realistic smaller sub tasks and operations. This will show an overall structure of the main user tasks according to Hackos, J. & Redish, J. (1998).

The process of task decomposition shows the sequencing of activities by ordering them from left to right. In order to break down a task, the processes of how a task should be done were specified first. The task decomposition was carried out using the following stages: -

1. Task to be analyzed was specified first. The final objective of a user browsing a web page is to complete the particular task he or she has in mind.

2. This final task was broken down into between 4 and 8 subtasks. These subtasks are specified in terms of objectives and, between them, should cover the whole area of interest. The subtasks identified were to obtain details, compare information, to complete a transaction or mere browsing.
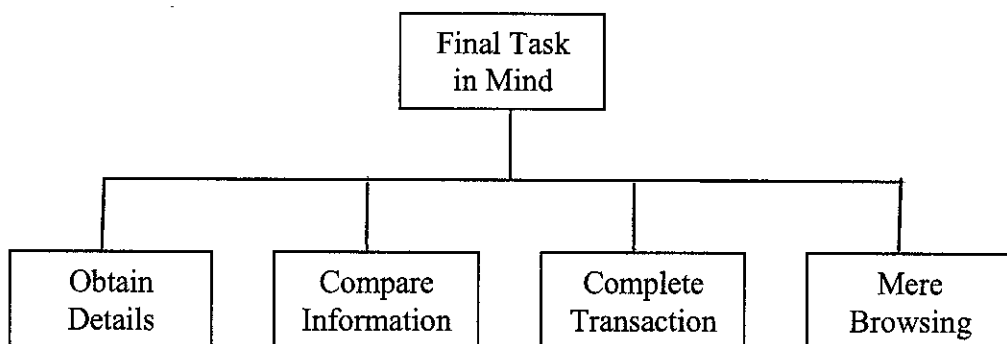
Figure 3.4   Task Decomposition

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3. A diagram was produced to ensuring that it was complete.

4. The analysis was the presented to an Internet user who visit profit-making web pages to check for consistency.

3.4   Ensuring Usability and Accessibility

To ensure usability and accessibility, the author had decided to adopt the User-Centred Design (UCD) approach while constructing the User Interface (UI).

Ian Sommerville (2000) explained that User-Centred Design (UCD) is an approach to UI design where the needs of the user are paramount and where the user is actively involved in the design process. He also mentioned that UI design always involves the development of prototype interfaces.

Basically, the modification process of the UI adopted the prototyping methodology. Steps involved in the scoping of the mentioned prototype screens will be repeated till a satisfactory one is obtained. It is clearer illustrated through the graphical representation in the following page.

The author had decided to settle with this methodology because although it may seem tedious and repetitive but in order to design web pages which the target users will accept and use with much ease, it is therefore justified that this particular methodology is being adopt due to users' acceptance. When users are the pivot factor in consideration, acceptance level will be high.
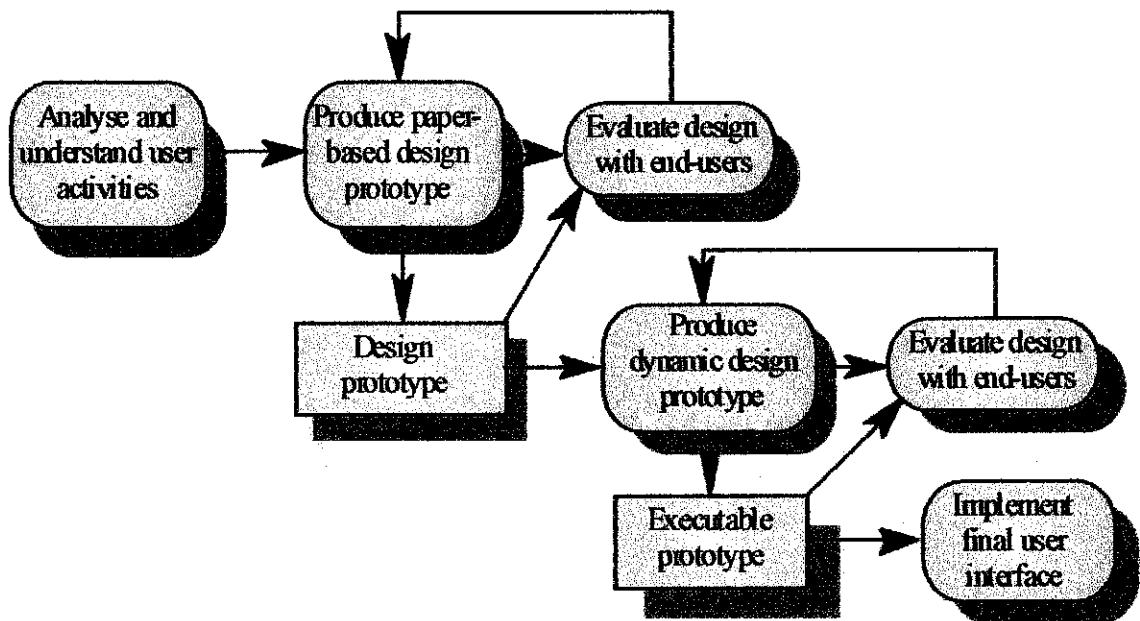
Figure 3.5 User Interface Design Process

(Adapted from Ian Sommerville, 2000)

3.4.1 User Interface (UI) Evaluation Techniques

Evaluation of a user interface design was carried out to assess its suitability for the target users. A full scale evaluation is very expensive and impractical for most systems and web pages. Ideally, an interface should be evaluated against a usability specification. The usability specification is formulated by the author through some researches and observations conducted throughout the User Consultation phase. Main evaluation techniques employed are: -

    a. Questionnaires for user feedback.

        Questionnaires were formulated with care and after many reliable references referred to obtain the most accurate and unbiased feedbacks from users. Kindly refer to the appendices section for the questionnaire mentioned.

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b. Video recording of system use and subsequent tape evaluation.

Video recording was able to track the effectiveness of web page design with considerations of HCI. A group of ten (10) users were gathered in the usability laboratory for this recording to be done. Users' activities were recorded for further evaluation for criteria such as ease of browsing, user hesitance level, effectiveness of support and help option and many more.

Testing the proper designed web pages and getting feedback from these specified users is the best way to see whether a particular UI design ideas are giving them what they want.

3.5   Consideration of Web Design Issues

User Interface (UI) design must take account of the needs, experience and capabilities of the targeted web page users. Designers should be aware of people's physical and mental limitations and should recognise that all people (referring to Internet users) make mistakes. Recent issues concerning web design and UI design were referred to and taken into consideration. Please kindly refer to the references for more detailed information. Recent issues which were concentrated are: -

a. User familiarity.

The interface should be based on user-oriented terms and concepts rather than computer concepts. Technical jargons are avoided during all design of web pages to allow ease of usage and to avoid confusions. Designing of web pages should be based on a logical mental model.

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b. Consistency.

The system should display an appropriate level of consistency. Commands and menus should have the same format; command punctuation should be similar and etc. to project professionalism and good corporate images while ensuring ease of browsing.

c. Minimal surprise.

When a command (a click of button) operates in a known way, the user should be able to predict the operation of similar commands. Users usually would not prefer surprise elements in web pages.

d. Recoverability.

The system should provide some resilience or flexibility to user errors and allow the user to recover from errors after they are made. This might include an undo facility, confirmation of destructive actions, 'soft' deletes and etc. to avoid frustrations.

e. User guidance.

Some user guidance such as help systems, on-line manuals, etc. should be supplied. User would not want to be 'lost' in a web site.

f. User diversity.

Interaction facilities for different types of user should be supported. For example, some users have seeing difficulties and so larger text should be available.

3.6　Developing A User Interface (UI) Design Specification

Three (3) sets of UI design principles were adapted from Microsoft Corporation, IBM Corporation and Jakob Nielsen for comparison and contrasting purposes, to formulate the final set of verified UI design principles or techniques. The following procedures were formulated to obtain the guidelines: -

1. Search for resources from the three (3) identified sources namely User-Centered Design Principles by Microsoft Corporation, Design Basics by IBM Corporation and Ten (10) Usability Heuristics by Jakob Nielsen.

2. Credibility of the mentioned sources was verified through usage of questionnaires.

3. Attributes in the identified sources were the placed into a table for comparison to identify the similar ones.

4. The similar attributes of Web Page Design Guidelines were summarized for further discussion in Chapter 4.

The finalized Human Computer Interaction (HCI) techniques for User Interface will be discussed in the next chapter under results and discussions.

CHAPTER 4

RESULTS AND DISCUSSIONS

4. RESULTS AND DISCUSSIONS

4.1 Analysis Result on Web Page Design Mistakes

There are Ten (10) Web Design Mistakes of 2003 by Jakob Nielsen (2003) which is the main concern of this reasearch. They were assinged a code each as illustrated in the following table for analysis purpose: -

Mistake Number	Type of Web Design Mistake
01	Unclear statement of purpose.
02	New Uniform Resource Locators (URLs) for archived content.
03	Undated content.
04	Small thumbnail images of big, detailed photos.
05	Overly detailed Alternative (ALT) text.
06	No "What-If" support.
07	Long lists that cannot be winnowed by attributes.
08	Products sorted only by brand.
09	Overly restrictive form entry.
10	Pages that link to themselves.

Table 4.1 Web Design Mistake Indicated by Code Number

In the following section, we would like to analyze in detailed the results of questionnaires being circulated among a group of test subjects. According to a survey done by the author to gather responses from a group of Information Technology (IT) undergraduate on the rating of web pages design mistakes according to the annoyance factor, it was found out that Mistakes 05, 10, 07, 01 and 02 are the top five (5). The

following table is able to provide a clearer view of the ranking based on the mistake's annoyance factor.

Web Design Mistakes and Its Significant Annoyance

Annoyance Caused to Users

Web Design Mistakes

- ▨ Mistake 01
- ■ Mistake 02
- □ Mistake 03
- ▢ Mistake 04
- ■ Mistake 05
- ▩ Mistake 06
- ■ Mistake 07
- ▨ Mistake 08
- ■ Mistake 09
- ■ Mistake 10
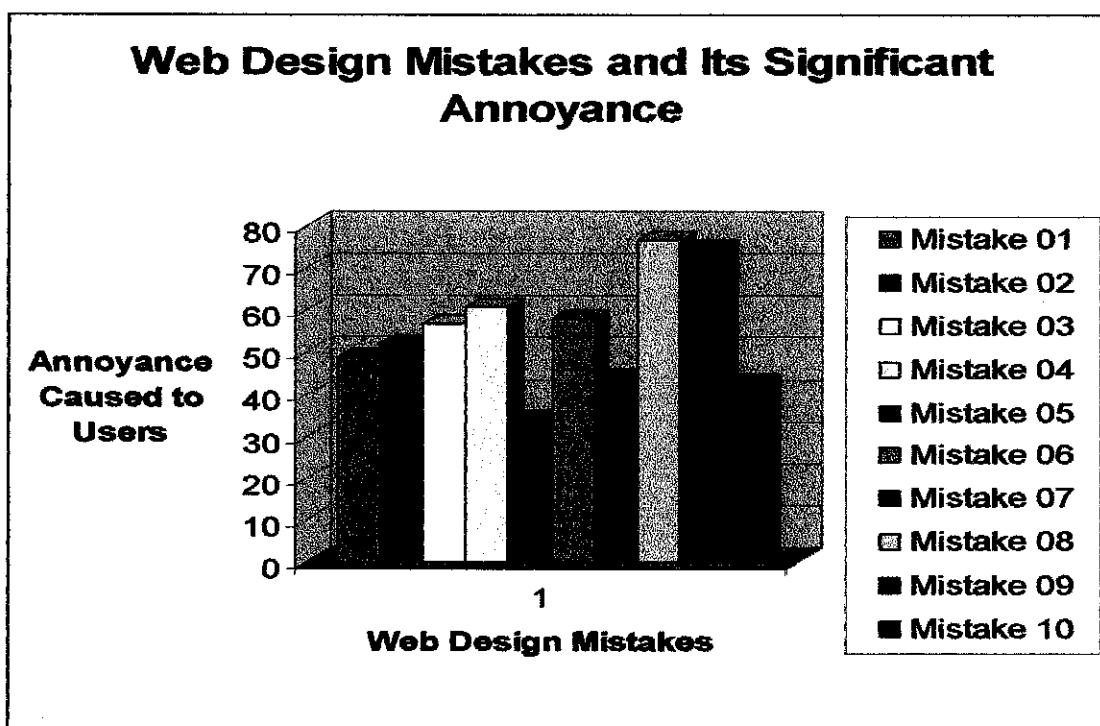
*The lower the figure on the y-axis indicates the higher the annoyance level.

Figure 4.1   Influence of Web Design Mistakes According to Its Annoyance (in Graphics)

The analysis was begun with the questionnaire being formulated. Users were asked to fill up the questionnaire sheets in this order. The most annoying mistake was assigned the value (1) followed by (2) for the next most annoying one. The least annoying mistake to a user was assigned the value (10) since that is the total number of mistakes tested. Eventually when the data was summarized, the most annoying mistakes will have the lowest value in the total sum and the least annoying mistake will have the highest total sum. This will be clearly illustrated in the appendix entitled Influence of Web Design Mistakes According to Its Annoyance (in Figures).In table format, when

sorted according to the rank, from the most annoying mistake to the least annoying one, the table would look like this.

Rank	Design Mistake	Type of Web Design Mistake
1	05	Overly detailed Alternative (ALT) text.
2	10	Pages that link to themselves.
3	07	Long lists that cannot be winnowed by attributes.
4	01	Unclear statement of purpose.
5	02	New Uniform Resource Locators (URLs) for archived content.
6	03	Undated content.
7	06	No "What-If" support.
8	04	Small thumbnail images of big, detailed photos.
9	09	Overly restrictive form entry.
10	08	Products sorted only by brand.

Table 4.2   Web Design Mistakes Ranked From the Most Annoying To the Least Annoying

When referring to profit-making web pages, it was found out that Overly detailed Alternative (ALT) text is the most annoying web mistake to the test subjects followed by Pages that link to themselves. The least annoying mistake is Products sorted only by brand since this was considered an additional function for business sites.

4.2   Comparisons of Web Design Attributes

There were many sources referred to further refine this research project concerning web design principles and rules of thumbs. However, the author would like to highlight three (3) credible sources which were taken for comparison purpose to signify the importance of each well-defined, practical web page design techniques or guidelines. The sources are from Jakob Nielsen – a guru in HCI, IBM Corporation and Microsoft Corporation. All three sources were identified to be credible and reliable for this research as their

credibility is tested out through Questionnaire 2. All information taken is up-to-date. Refer to the following table for better understanding. The overlapping design attributes by all the three (3) sources are highlighted: -

Microsoft Corporation (2004)	IBM Corporation (2004)	Jakob Nielsen (2004)
User in Control	Support: Place the user in control and provide proactive assistance	User control and freedom
Directness	Obviousness: Make objects and their controls visible and intuitive	Match between system and the real world
Consistency	Availability: Make all objects available at all times	Consistency and standards
Forgiveness	Encouragement: Make actions predictable and reversible	Help users recognize, diagnose, and recover from errors
Feedback	Satisfaction: Create a feeling of progress and achievement	Visibility of system status
Aesthetics	Affinity: Bring objects to life through good visual design	Aesthetic and minimalist design
Simplicity	Simplicity: Don't compromise usability for function	-
-	Familiarity: Build on users' prior knowledge	Recognition rather than recall
-	Safety: Keep the user out of trouble	Error prevention
-	Versatility: Support alternate interaction techniques	-
-	Personalization: Allow users to customize	Flexibility and efficiency of use
-	-	Help and documentation

Table 4.3   Comparison of Attributes for Web Design between Three (3) Identified Sources

All three entities agreed on six (6) web design guidelines that should not be overlook by practitioners and designers in all web page design. The finalized common attributes that should be in every web page designs are: -

1. User Control

User needs to feel in charge of the system and should not feel restricted by a system. User should be able to accomplish task without the restriction of the web page 'directing' and telling the user what to do.

2. Directness

All 'dialogues' between the user and the system which resides in the web pages should be in a direct and natural manner. This should be developed based on a real-life metaphor. User should feel at ease and interacts with the web pages naturally without much ambiguity.

3. Consistency

Platform conventions should be used to ensure consistency. User should not be left wondering the position of a certain command or link but instead, consistent naming conventions, buttons and position of screens should be the same between web pages in a site. Users have no need to remember tedious information from previous page which will upset the process of interaction.

4. Forgiveness

The UIs should allow user to explore the functions between the pages and provide only suggestions before user make a drastic mistakes. The UI should be equipped with error prevention messages to warn users in simple, understandable language. Recovery from error should also be included at the disposable of users.

5. Feedback

Changes should be seen on screens whenever user makes changes. This will ensure that user knows about the system status and processes being carried out. User will then be more confident to proceed with his / her tasks. There should be no idle screen because users will get impatient.

6. Aesthetics

Users must have direct, clear visual cues when looking at a web page. They should be able to visualize their next task. Keep important elements visible and clear and irrelevant information out of sight. In a study conducted by Jakob Nielsen and John Morkes (1997), it was proven that aesthetic in web page presentation plays an important part in ensuring usability. Please refer to the following table for comparison of the before and after improvements in a text paragraph: -

Site Version	Sample Paragraph	Usability Improvement (relative to control condition)
Promotional writing (control condition) using the "marketese" found on many commercial websites	Nebraska is filled with internationally recognized attractions that draw large crowds of people every year, without fail. In 1996, some of the most popular places were Fort Robinson State Park (355,000 visitors), Scotts Bluff National Monument (132,166), Arbor Lodge State Historical Park & Museum (100,000), Carhenge (86,598), Stuhr Museum of the Prairie Pioneer (60,002), and Buffalo Bill Ranch State Historical Park (28,446).	0% (by definition)
Combined version using all three improvements in writing style together: concise, scannable, and objective	In 1996, six of the most-visited places in Nebraska were: • Fort Robinson State Park • Scotts Bluff National Monument • Arbor Lodge State Historical Park & Museum • Carhenge • Stuhr Museum of the Prairie Pioneer • Buffalo Bill Ranch State Historical Park	124%

"Marketese" = the promotional writing style with boastful subjective claims ("hottest ever") that currently is prevalent on the Web.

Table 4.4 Measuring the Effect of Improved Web Presentation which Promotes Usability

(Adapted from Jakob Nielsen, John Morkes – Writing for the Web, 1997)

4.3   Illustrations of Good Practices in Web Page Designs

As web page designing mistakes are now identified, to eliminate these mistakes, it is always a good practice to refer to a few available illustrations of good practices as shown by the following graphics and web pages print screens. These good practices are exhibited by well-known multinational organizations in their corporate web pages.

Web page design concerns have been such an important issue in the midst of its advancement and development in this technological era caused Lynch and Horton to look into this issue in year 2002. The examples fulfill the attributes mentioned earlier.

a. Clear navigation aids to promote and provide user control.

Most user interactions with web pages involve navigating hypertext links between documents. The main interface problem in web sites is the lack of a sense of where you are within the local organization of information.
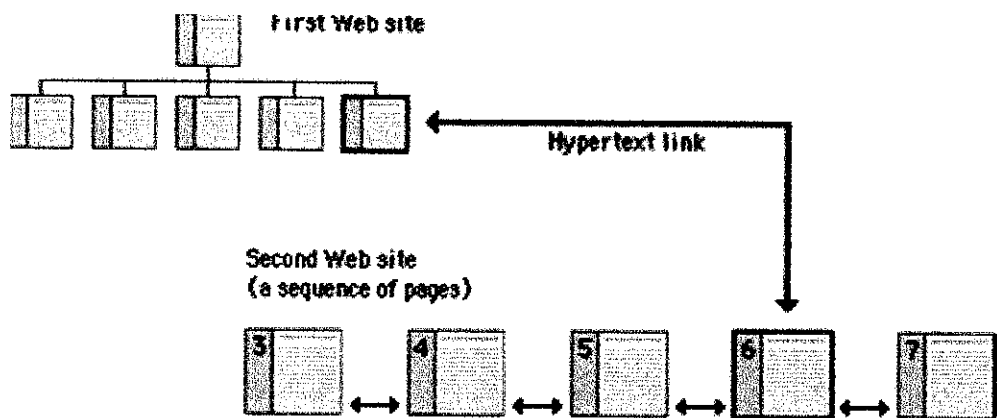
Figure 4.2   Representation of Clear Navigation Aid within Inner Level of a Web Site

(Ten Good Deeds in Web Design, Jakob Nielsen, 1999)

Clear, consistent icons, graphic identity schemes, and graphic or text-based overview and summary screens can give the user confidence that they can find what they are looking for without wasting time.

Users should always be able to return easily to the home page and to other major navigation points in the site. These basic links should be present and

in consistent locations on every page. Graphic buttons will provide basic navigation links and create a graphic identity that tells users they are within the site domain.

The button bar is efficient (offering multiple choices in a small space) and predictable (it is always there, at the top of every page), and it provides a consistent graphic identity throughout the site . In the following page for example, the graphic header appears on every page.

Figure 4.3   Illustration of a Consistent Graphic Header

<u>**www.fastcompany.com**</u>

(Ten Good Deeds in Web Design, Jakob Nielsen, 1999)

b. No dead-end pages to promote forgiveness.

Web pages often appear with no preamble or an introduction: readers can make or follow links directly to subsection pages buried deep in the

hierarchy of web sites. They may never see the home page or other introductory site information. If a subsection pages do not contain links to the home page or to local menu pages, all web pages in a site had to have at minimum a link back to the main "home" page or, better yet, a home page link along with links to the other sections of the site.
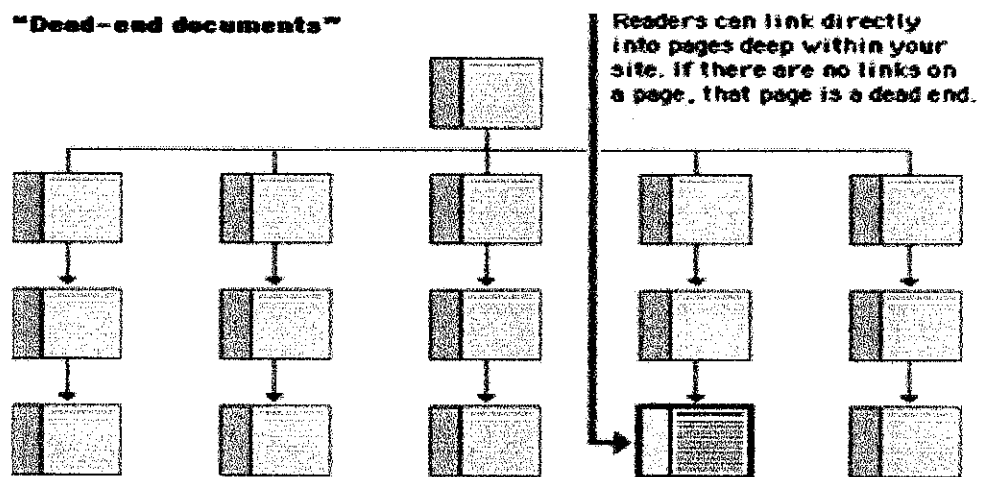
Figure 4.4 Representation of Effective Link to Every Available Web Page in a Site

(Ten Good Deeds in Web Design, Jakob Nielsen, 1999)

c. Direct access (Directness).

Users want to get information in the fewest possible steps. This means that the design must have an efficient hierarchy of information to minimize steps through menu pages. Studies have shown that users prefer menus that present at least five to seven links and that they prefer a few very dense screens of choices to many layers of simplified menus. The following table demonstrates that you do not need many levels of menus to incorporate lots of choices: -

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	Number of menu items listed			
Number of nested menus	5	7	8	10
1	5	7	8	10
2	25	49	64	100
3	125	343	512	1000

Table 4.5   Level of Nested Menus and Choices Available

(Ten Good Deeds in Web Design, Jakob Nielsen, 1999)

d. Simplicity and consistency (Consistency).

Users are not impressed with complexity that seems unnecessary, especially home users who may be depending on the site for timely and accurate work-related information. Interface metaphors should be simple, familiar, and logical. Highly unusual, "creative" navigation and home page metaphors always fail because they impose an unfamiliar, unpredictable interface burden on the user.

Tab-based navigation; users know what to do without having to decode the metaphor

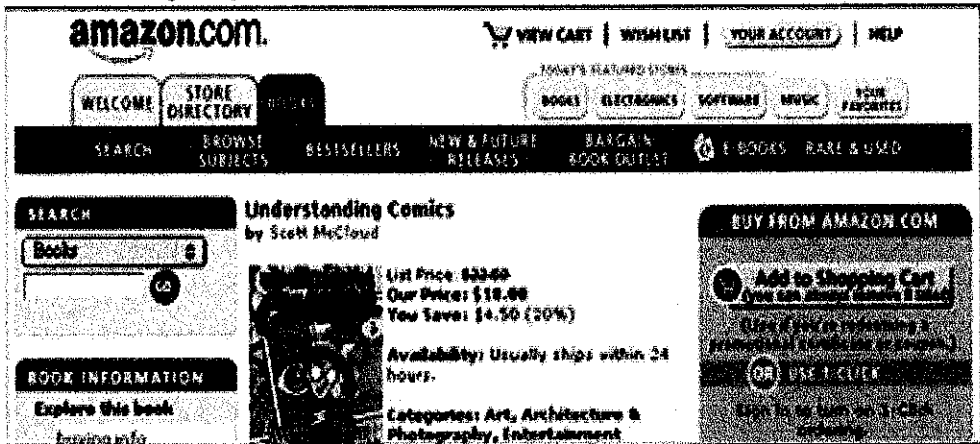**Figure 4.5   Demonstration of Easy-to-Understand Metaphor**

<www.amazon.com>

(Web Style Guide, Lynch and Horton, 2002)

Figure 4.6   Illustration of Simple Metaphor in Button Design

<www.adobe.com>

(Web Style Guide, Lynch and Horton, 2002)

The user interface for a web site should follow the general navigation and layout conventions of major web sites because most users are already used to those conventions ones. Users spend most of their time on sites different sites, so highly unusual interfaces should be avoided to attract and keep a large audience.

The best information designs are never noticed. An excellent model of interface design is the Adobe Corporation web site as illustrated in the previous page. Graphic headers act as navigation aids and are consistently applied across every page in the site. Once you know where the standard links are on the page header graphics, the interface becomes almost invisible and navigation is easy.

For maximum functionality and legibility, a page and site design should be built on a consistent pattern of modular units that all share the same basic layout grids, graphic themes, editorial conventions, and hierarchies of organization. The goal is to be consistent and predictable; users should feel comfortable exploring a site and confident that they can find what they need. The graphic identity of a series of pages in a web site provides visual cues to the continuity of information. The header menu graphics present on every page of the Adobe's site create a consistent user interface and corporate identity.
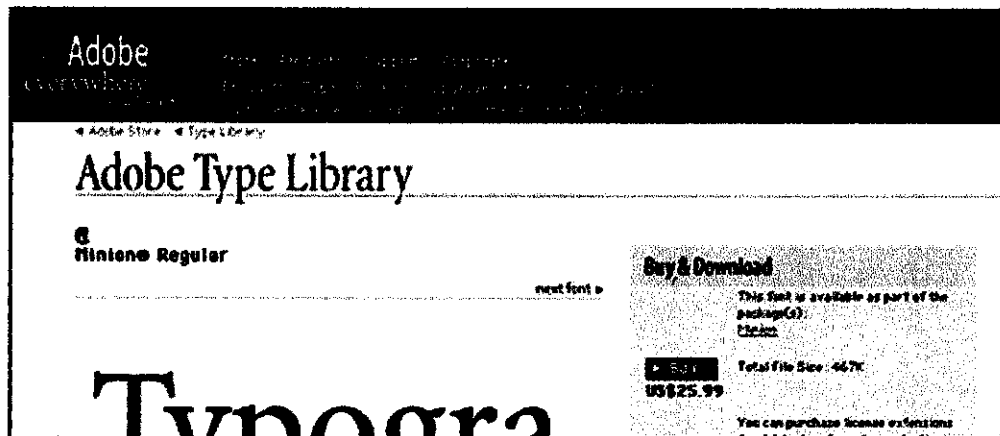
Figure 4.7   Representation of Consistent Header in Web Pages

<www.adobe.com/type>

(Web Style Guide, Lynch and Horton, 2002)

Even when a site design does not employ navigation graphics, a consistent approach to the layout of titles, subtitles, page footers, and navigation links to its own home page or related pages will reinforce the reader's sense of context within the site.

e.   Design integrity and stability to promote aesthetics.

To convince users that what a page has to offer is accurate and reliable, one will need to design a web site as carefully as any other type of corporate communication, using the same high editorial and design standard. A site that looks sloppily built, with poor visual design and low editorial standards, will not inspire confidence.

Functional stability in any web design means keeping the interactive elements of the site working reliably. Functional stability has two components: getting things right the first time during designing, and then keeping things functioning smoothly over time. Good web sites are

inherently interactive, with lots of links to local pages within the site as well as links to other sites on the web. Information changes quickly on the web. After the site is established, there will be need to check that all links are still working properly and that the content supplied remains relevant.

f. Feedback and dialog (Feedback).

Web design should offer constant visual and functional confirmation of the user's whereabouts and options, via graphic design, navigation buttons, or uniformly placed hypertext links. Feedback also means being prepared to respond to users' inquiries and comments. Well designed web sites provide direct links to the web site editor or webmaster responsible for running the site. Planning for this ongoing relationship with users of web pages is vital to the long-term success of enterprises.

g. Bandwidth and interaction.

This particular issue is discussed in details because the author identified this as one of the most important concerns to all Internet users. Users will not tolerate long delays therefore feedback fro web page should be almost instant after every user actions. Research has shown that for most computing tasks the threshold of frustration is about ten seconds. Web page designs that are not well "tuned" to the network access speed of typical users will only frustrate them. If target users are primarily general public browsers "surfing" the Web via dial-up modem connections, it is foolish to put huge bitmap graphics on your pages because the average modem user will not be patient enough to wait while all graphics download over the phone line. But when building a university or corporate intranet site where most users will access the web server at Ethernet speeds or better, this can allow more ambitious use of graphics and multimedia. Many home computer users can now use

high-speed DSL (Digital Subscriber Line) or cable modems to access the web. However, industry observers expect that it will be at least another five years before web designers can count on most home users having access to high-speed web connections. In general, be conservative with web graphics. Even users with high-speed connections appreciate a fast-loading page.

4.4   Results of Good Practices in Web Page Design

The implication when considering Human Computer Interaction (HCI) techniques, principles and guidelines in web page design will result in tremendous improvements such as illustrated in the following graphs. This result was proven to be positive as demonstrated by Melody Y. Ivory and Rashmi R. Sinha entitled "Empirically Validated Web Page Design Metrics" (2000). The graphs illustrated the scores assigned for many selected web pages which are assigned by industries experts. This is because the final objective of the survey as highlighted by the mentioned researchers is to "provide an empirical foundation for web site design guidelines".

There are actually points assigned to categories of web pages before the redesign and after these sites are redesigned carefully with considerations of guidelines and experts feedbacks.
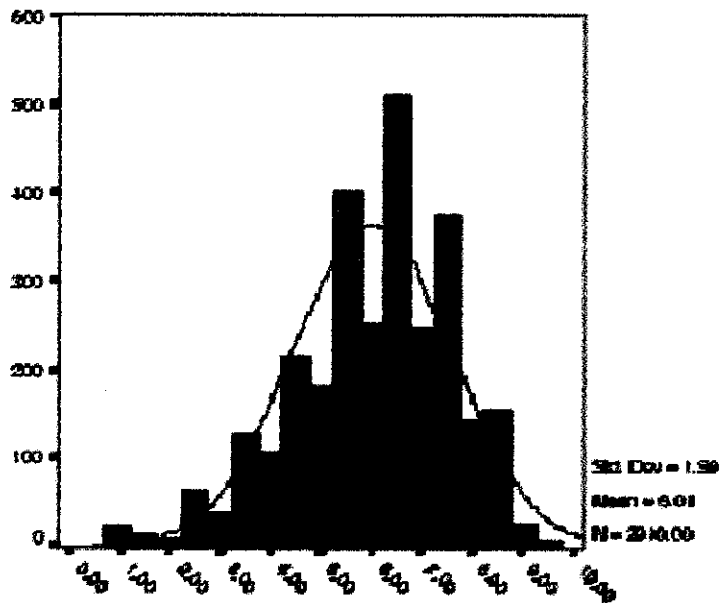
* The x axis is the overall score and the y axis is the number of sites assigned this score.

Figure 4.8   Histogram of the the overall scores assigned to the sites considered for the 2000 Webby Awards

The following table clearly illustrates the differences in the web page effectiveness and improvements. The score was assigned on the scale of zero (0 – being most ineffective) to ten (10 – being most effective). The results of improvements are illustrated in percentage as well as all figures indicate increases in the points assigned after the redesigning process.

	Overall	Community	Education	Finance	Health	Living	Services
After	6.97	6.58	6.47	6.60	7.90	6.66	7.54
Before	5.47	5.66	5.38	5.80	6.40	5.66	5.90
Improve	1.50	0.92	1.09	0.80	1.50	1.00	1.64
+ (%)	27.42	16.25	20.26	13.79	23.44	17.67	27.80

Table 4.6   Comparison of Web Pages Scoring With and Without Web Design Techniques Considerations

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There is a tremendous improvement seen on the overall score of the selected web pages arranged according to six (6) different web site categories. It is therefore important to consider web design techniques in all commercial web pages.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

5. CONCLUSION AND RECOMMENDATIONS

5.1 Summary of Project

The research title had given an overall idea of what the project is all about. The problem statements in Chapter 1 had clearly outlined the need for this research to be carried out. Although the number of web pages is growing tremendously, web designers however are neglecting the web design issues. This has reached an alarming level and many well known organizations and individuals like Jakob Nielsen had taken the initiative to look into the matter, conducted appropriate researches to establish designing techniques for web pages with the considerations of Human Computer Interaction (HCI) Factors. The author had also seen the opportunity to base her research on the problem.

HCI covers a very wide area and in order to complete this study, the user focused on the User-Centered (UC) design issues and evaluation techniques as highlighted in HCI. In order to come out with this final dissertation, many meetings were conducted and references made to adhere to the strict documentation requirements set by the university. However, this has been taken as a challenge and had proved to be manageable by the author.

This particular project title had focused on the 'soft aspect' of computer science which is HCI. This aspect has been off the Information Technology (IT) personnel's vocabulary for the longest time which has directly contributed to the deterioration in

quality of web designing. This research had brought the attention of many back to the focus of HCI in all aspects of computer science.

It is always important to support a research with examples of good practices. Print-screens of well-designed web pages are all over Chapter 4 for all future references in all web page design, and this is applicable to almost everyone – users, designers, owners, institutions, researchers and etc.

5.2   Recommendations

Based on the study conducted, it is known that there are many more aspects oh HCI which we could look into. Currently, the project was done focusing more on researches in the computer science aspect. It is hoped that the project can be further modified and improved to cover more technical aspects of HCI.

To further improve this research, the author would like to conduct more usability laboratory tests in order to cover more web design principles and guideline. Thorough research will be done with more references from many more credible and reliable sources. The author would like to look into more aspects of HCI, usability and evaluation techniques used to verify usability.

Actually, there are more lab studies that could be conducted with a larger sample size for each test to obtain a more diversified and accurate survey results. As a summary for future works, the author would like to suggest the following: -

1. Research in the area of human psychology, observing human perception and mental process while interacting with commercial web pages.

2. More detailed and in depth usability lab researches be conducted on the finalized web design attributes to cement the important of HCI considerations in web page design.

5.3   Conclusions

This research project had indeed broadened the authors view in the area of Human Computer Interaction (HCI) and User Interface (UI) design specializing in web pages of profit-making organizations and individuals. Many terms and concepts which were never come across were learned and applied.

In short, although confined by the due date, the objectives of the project were all covered and achieved. With the rule of thumbs being formulated, it is hoped that the current problem of poor web page design would be solved. Future studies, findings and researches are needed to further support and strengthen the result of this project.

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APPENDICES

APPENDIX 1

QUESTIONNAIRE 1

I am a final year Information System undergraduate from Universiti Teknologi PETRONAS (UTP), currently completing my final year project on Application of Human Computer Interaction (HCI) Techniques to the Redesign of User Interface.

The purpose of this questionnaire is to help me gather some vital information from the general Internet / Web Page users for my research purpose. Kindly take a few moments to complete the questionnaire. Thank you.

On a scale of 1 to 10, rate the following web design mistakes from the most annoying (1) to the least prominent (10).

☐ **Unclear Statement of Purpose.**
When entering a Web Page, you do not immediately know what the Web Page does.

☐ **New Uniform Resource Locators (URLs) for Archived Content.**
Some information although vital, is placed behind and can only be accessed by links. Important information is not displayed in main page.

☐ **Undated Content.**
You would not know whether you are acquiring some up-to-date information or those which are obsolete because no date of creation or modification is recorded.

☐ **Small Thumbnail Images of Big and Detailed Photos.**
Although using small thumbnails for large photos reduces a Web Page downloading time, but take a look at this photo.

You will only see 3 people but in reality it is a picture of our former Prime Minister Tun Mahathir Mohamad with two other ministers during The Special Session of the Islamic Conference of Foreign Ministers on Terrorism.

☐ **Overly Detailed Alternative (ALT) Text.**
Some Web Pages are using ALT text instead of pictures and graphical representations which does not bring across the real message. Instead of showing a pie chart, the results of a discussion is put in word.

☐ **No "What-If" Support.**
Some Web Pages do not offer support or even the most fundamental help button / option.

☐ **Long Lists that cannot be winnowed by Attributes.**
In many Web Pages, search results are just displayed in a row without groupings according to its characteristics or keywords.

☐ **Products Sorted Only by Brand.**
Instead there should be other options like products being sorted according to price range or availability for easier browsing.

☐ **Overly Restrictive Form Entry.**
E.g. Contact Number ___-___-_____ or NRIC _____-__-____

☐ **Pages that Link Back to Themselves.**
This refers to Web Pages which have many different naming for links which actually redirect users back to the same page.

i

APPENDIX 2

QUESTIONNAIRE 2

1. Have you heard of Microsoft Corporation?

   Yes / No

2. Have you heard of IBM Corporation?

   Yes / No

3. Have you heard of Jakob Nielsen?

   Yes / No

For More Information about Jakob Nielsen, please kindly visit http://www.useit.com/jakob/ for this verification.

Jakob Nielsen has been called:
"the king of usability" (Internet Magazine)
one of the top ten minds in small business (FORTUNE Small Business)
number 6 of the Web's 10 most influential people (ZDNet)
"the guru of Web page usability" (The New York Times)
"the next best thing to a true time machine" (USA Today)
"the smartest person on the Web" (ZDNet AnchorDesk)
"the world's leading expert on Web usability" (U.S. News & World Report)
"the world's leading expert on user-friendly design" (Stuttgarter Zeitung, Germany)
"knows more about what makes Web sites work than anyone else on the planet" (Chicago Tribune, March 6, 2000)
"one of the world's foremost experts in Web usability" (Business Week)
"the Web's usability czar" (WebReference.com)
"the reigning guru of Web usability" (FORTUNE)
"eminent Web usability guru" (CNN)
"perhaps the best-known design and usability guru on the Internet" (Financial Times)
"the usability Pope" (Wirtschaftswoche Magazine, Germany)
"new-media pioneer" (Newsweek)
"not yet as famous as Elvis" (CONTENTIOUS Magazine)

Jakob Nielsen, Ph.D., is a User Advocate and principal of the Nielsen Norman Group which he co-founded with Dr. Donald A. Norman (former VP of research at Apple Computer). Until 1998 he was a Sun Microsystems Distinguished Engineer.

Dr. Nielsen founded the "discount usability engineering" movement for fast and cheap improvements of user interfaces and has invented several usability methods, including heuristic evaluation. He holds 74 United States **patents**, mainly on ways of making the Internet easier to use.

4. Do you believe these sources to be credible for formulating Web Page Design Principles and Guidelines for Web Page Design?

   Yes / No

APPENDIX 3

Web Design Mistake Analysis

	S- 01	S- 02	S- 03	S- 04	S- 05	S- 06	S- 07	S- 08	S- 09	S- 10	Sum
M- 01	1	6	5	2	2	10	7	9	6	1	49
M- 02	2	8	8	7	9	6	2	4	3	3	52
M- 03	9	10	4	3	7	9	8	3	2	2	57
M- 04	8	5	2	10	6	5	3	8	10	4	61
M- 05	6	1	3	5	1	1	6	5	1	5	34
M- 06	5	7	6	6	3	4	9	7	4	7	58
M- 07	4	2	7	4	4	2	4	2	7	8	44
M- 08	7	9	9	8	10	3	10	10	5	6	77
M- 09	10	4	10	9	5	8	5	6	8	10	75
M- 10	3	3	1	1	8	7	1	1	9	9	43

* *M = Design Mistake, S = Subject of Test*, the lower the sum indicates the higher the annoyance level.

Influence of Web Design Mistakes According to Its Annoyance

(in Figures)

Ranking of Web Design Mistakes
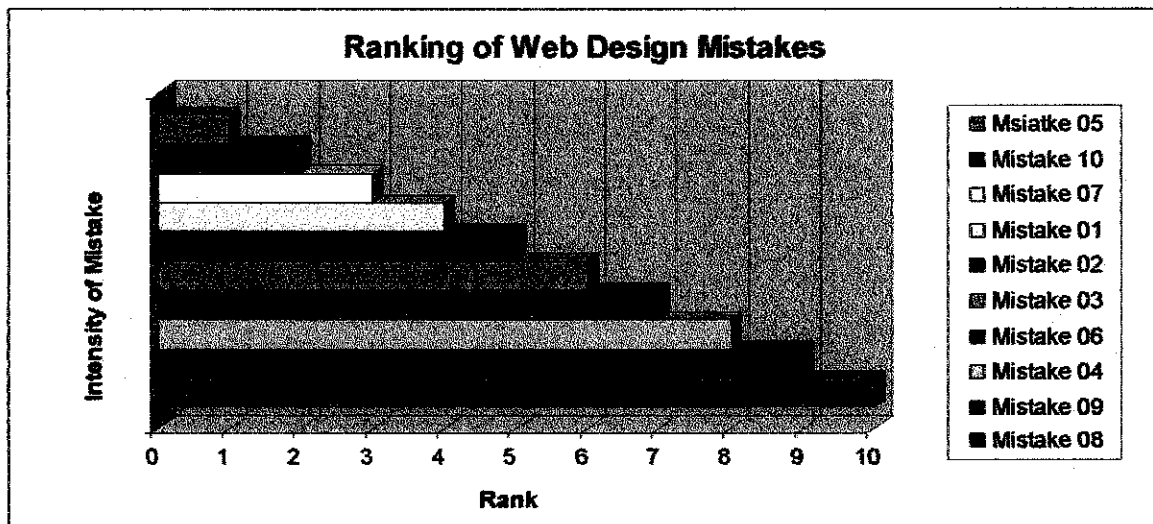
Prioritization of Web Design Mistakes According to Its Intensity

APPENDIX 4

Comparison of Attributes of Web Design between Three (3) Identified Sources

Microsoft Corporation (2004)	IBM Corporation (2004)	Jakob Nielsen (2004)
User in Control	Support: Place the user in control and provide proactive assistance	User control and freedom
Directness	Obviousness: Make objects and their controls visible and intuitive	Match between system and the real world
Consistency	Availability: Make all objects available at all times	Consistency and standards
Forgiveness	Encouragement: Make actions predictable and reversible	Help users recognize, diagnose, and recover from errors
Feedback	Satisfaction: Create a feeling of progress and achievement	Visibility of system status
Aesthetics	Affinity: Bring objects to life through good visual design	Aesthetic and minimalist design
Simplicity	Simplicity: Don't compromise usability for function	-
-	Familiarity: Build on users' prior knowledge	Recognition rather than recall
-	Safety: Keep the user out of trouble	Error prevention
-	Versatility: Support alternate interaction techniques	-
-	Personalization: Allow users to customize	Flexibility and efficiency of use
-	-	Help and documentation

Sources (Websites): -
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Microsoft Corporation

1. User in Control

An important principle of user interface design is that the user should always feel in control of the software rather than feeling controlled by the software.

2. Directness

Design your software so that users can directly manipulate software representations of information. Familiar metaphors provide a direct and intuitive interface for user tasks. Metaphors support user recognition rather than recollection. Users remember a meaning associated with a familiar object more easily than they remember the name of a particular command.

3. Consistency

Consistency allows users to transfer existing knowledge to new tasks, learn new things more quickly, and focus more attention on tasks. This is because they do not have to spend time trying to remember the differences in interaction. By providing a sense of stability, consistency makes the interface familiar and predictable. Consistency is important through all aspects of the interface, including names of commands, visual presentation of information, operational behavior, and placement of elements on the screen and within windows.

4. Forgiveness

Users like to explore an interface and often learn by trial and error. An effective interface allows for interactive discovery. It provides only appropriate sets of choices and warns users about potential situations where they could damage the system or data, or better, makes actions reversible or recoverable. Even in the best-designed interface, users can make mistakes. These mistakes can be both physical (accidentally pointing to the wrong command or data) and mental (making a wrong decision about which command or data to select). An effective design avoids situations that are likely to result in errors. It also accommodates potential user errors and makes it easy for the user to recover.

5. Feedback

Always provide feedback for a user's actions. Good feedback helps confirm that the software is responding to input and communicates details that distinguish the nature of the action. Effective feedback is timely and is presented as close to the point of the user's interaction as possible. Even when the computer is processing a particular task, provide the user with information about the state of the process and how to cancel the process if that is an option. Nothing is more disconcerting to users than a "dead" screen that is unresponsive to input.

6. Aesthetics

Visual design is an important part of an applications interface. Visual attributes provide valuable impressions and communicate important cues to the interactive behavior of particular objects. At the same time, it is important to remember that every visual element that appears on the screen potentially competes for the user's attention. Provide a coherent environment that clearly contributes to the users understanding of the information presented.

7. Simplicity

An interface should be simple (not simplistic), easy to learn, and easy to use. It must also provide access to all functionality of an application. Maximizing functionality and maintaining simplicity work against each other in the interface. An effective design balances these objectives. Simplicity also correlates with familiarity; things that are familiar often seem simpler. Whenever possible, try to build connections that draw on your users existing knowledge and experiences.

IBM Corporation

1. Simplicity: Don't compromise usability for function

Keep the interface simple and straightforward. Users benefit from function that is easily accessible and usable. A poorly organized interface cluttered with many advanced functions distracts users from accomplishing their everyday tasks. A well-organized interface that supports the user's tasks fades into the background and allows the user to work efficiently. Basic functions should be immediately apparent, while advanced functions may be less obvious to new users. Function should be included only if a task analysis shows it is needed. Therefore, keep the number of objects and actions to a minimum while still allowing users to accomplish their tasks.

2. Support: Place the user in control and provide proactive assistance

To give users control over the system, enable them to accomplish tasks using any sequence of steps that they would naturally use. Don't limit them by artificially restricting their choices to your notion of the "correct" sequence.

3. Familiarity: Build on users' prior knowledge

Allow users to build on prior knowledge, especially knowledge they have gained from experience in the real world. A small amount of knowledge, used consistently throughout an interface, can empower the user to accomplish a large number of tasks. Concepts and techniques can be learned once and then applied in a variety of situations. Users should not have to learn new things to perform familiar tasks. The use of concepts and techniques that users already understand from their real world experiences allows them to get started quickly and make progress immediately.

4. Obviousness: Make objects and their controls visible and intuitive

Where you can, use real-world representations in the interface. Real-world representations and natural interactions (direct action) give the interface a familiar look and feel and can make it more intuitive to learn and use. Icons and windows were early attempts to draw on user experiences outside the computing domain. The controls of the system should be clearly visible and their functions identifiable. Visual representations provide cues and reminders that help users understand roles, remember relationships, and recognize what the computer is doing. For example, the numbered buttons on the telephone object indicate that they can be used to key in a telephone number.

5. Encouragement: Make actions predictable and reversible

A user's actions should cause the results the user expects. In order to meet those expectations, the designer must understand the user's tasks, goals, and mental model. Use terms and images that match users' task experience, and that help users understand the objects and their roles and relationships in accomplishing tasks. Users should feel confident in exploring, knowing they can try an action, view the result, and undo the action if the result is unacceptable. Users feel more comfortable with interfaces in which their actions do not cause irreversible consequences.

6. Satisfaction: Create a feeling of progress and achievement

Allow the user to make uninterrupted progress and enjoy a sense of accomplishment. Reflect the results of actions immediately; any delay intrudes on users' tasks and erodes confidence in the system. Immediate feedback allows users to assess whether the results were what they expected and to take alternative action immediately. For example, when a user chooses a new font, the font of all applicable text, or of sample text, should change immediately. The user can then decide if the effect is what was desired and, if not, can change it before switching attention to something else.

7. Availability: Make all objects available at all times

Users should be able to use all of their objects in any sequence and at any time. Avoid the use of modes, those states of the interface in which normally available actions are no longer available, or in which an action causes different results than it normally does.

8. Safety: Keep the user out of trouble

Users should be protected from making errors. The burden of keeping the user out of trouble rests on the designer. The interface should provide visual cues, reminders, lists of choices, and other aids, either automatically or on request. Humans are much better at recognition than recall. Contextual and hover help, as well as agents, can provide supplemental assistance. Simply stated, eliminate the opportunity for user error and confusion.

9. Versatility: Support alternate interaction techniques
Allow users to choose the method of interaction that is most appropriate to their situation. Interfaces that are flexible in this way are able to accommodate a wide range of user skills, physical abilities, interactions, and usage environments.

10. Personalization: Allow users to customize
The interface should be tailor-able to individual users' needs and desires. No two users are exactly alike. Users have varying backgrounds, interests, motivations, levels of experience, and physical abilities. Customization can help make an interface feel comfortable and familiar.

11. Affinity: Bring objects to life through good visual design
The goal of visual design in the user interface is to surface to the user in a cohesive manner all aspects of the design principles. Visual design should support the user model and communicate the function of that model without ambiguities. Visual design should not be the "icing on the cake" but an integral part of the design process. The final result should be an intuitive and familiar representation that is second nature to users.

Jakob Nielsen

1. Visibility of system status
The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

2. Match between system and the real world
The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

3. User control and freedom
Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.

4. Consistency and standards
Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

5. Error prevention
Even better than good error messages is a careful design which prevents a problem from occurring in the first place.

6. Recognition rather than recall
Make objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

7. Flexibility and efficiency of use
Accelerators -- unseen by the novice user -- may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.

8. Aesthetic and minimalist design
Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

9. Help users recognize, diagnose, and recover from errors
Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.

10. Help and documentation
Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's task, list concrete steps to be carried out, and not be too large.