A Design Method for an Intuitive Web Site

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Abstract

The paper describes a methodology for designing a web site for human factor engineers that is applicable for designing a web site for a group of people. Many web pages on the World Wide Web are not organized in a format that allows a user to efficiently find information. Often the information and hypertext links on web pages are not organized into intuitive groups. Intuition implies that a person is able to use their knowledge of a paradigm to solve a problem. Intuitive groups are categories that allow web page users to find information by using their intuition or mental models of categories. In order to improve the human factors engineers efficiency for finding information on the World Wide Web, research was performed to develop a web site that serves as a tool for finding information effectively. The paper describes a methodology for designing a web site for a group of people who perform similar task in an organization.
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INTRODUCTION

Presently the World Wide Web (WWW) is used to present, advertise, and collect information. Web sites owned by corporations such as Microsoft (www.microsoft.com) and Corel (www.corel.com), are used to advertise their software. Other web sites such as Hotmail (www.hotmail.com) and Xavier Openmail (www.xula.edu) collect information from web site users and relay the information to other web site users.

Unfortunately, many WWW sites are poorly designed. Many web sites lack information that can help a user easily locate his or her desired information. Some items web sites lack that are valuable to web site users are date stamps, titles, universal html coding, proper graphics, and active links. Web pages should feature these items because the items help user find information.

As a result of the poorly designed web pages many web site users conclude the web site is inefficient, unintuitive, or an unorganized source of information because the web site causes the web site user to waste time searching for information. The human factors engineers at Sandia National Laboratories Organization 12323 have felt similarly. These engineers viewed many web sites in the WWW as ineffective, confusing, and disarrayed. An example is if the engineers desire to look at web pages with lifting equations, they will have to search the WWW with a search engine and look through many pages. Another example is the engineers bookmarking web pages which become too numerous to be effective. As a result of searching for information in the WWW the engineers wasted valuable time they could use to perform other tasks related to their job.

Presently, the human factors engineers are experiencing the same problems and desired a means to more effectively utilize information in the WWW. A solution to the human factors engineers' problem of locating their desired information on the WWW is to design a web site that caters to their needs. In order to develop such a web site for the human factors engineers, research was initiated with the goal of designing a web site that followed the unique requirements of human factors engineers and that is intuitive to human factors engineers. The research involved studying and applying task analysis, human factor principles, hypertext markup language and usability testing.
BACKGROUND

TASK ANALYSIS

Task analysis is a method of analyzing the tasks and duties performed by workers in an organization in order to determine the requirements of a web site for an organization (Forsythe, Grose, Ratner, 1998). These requirements are established by implementing two phases of task analysis. These phases are planning and analysis.

Planning

The planning phase is a process of ascertaining the purpose for creating a web site (Forsythe, Grose, Ratner, 1998). The purpose is obtained through developing goals for the web site, and understanding users and their environment (Forsythe, Grose, Ratner, 1998). The phase of developing goals for the web site is a process of establishing expectations for the web site. Some examples of goals for a web site are "attract web users to the web site", "communicate ideas", and "support electronic commerce". The phase of understanding users and the user environments, attempts to understand usage characteristics of prospective site users in their environment (Forsythe, Grose, Ratner, 1998). A usage characteristic describes the manner in which a device in the environment of a user will potentially affect a web site. An example of a usage characteristic is the location of the web site. If a web site is external, a variety of software and network connections need to be accommodated as compared to an internal site, which will need to accommodate a variety of business needs. Another example is the type of Internet connection a user will utilize. If web site users possess an ISDN or T1 line instead of 14.4 kps lines, a web site can contain many graphics because an ISDN or T1 line has a large bandwidth. However, if the primary users of a web site utilize Internet connections that are slower than 14.4 kps then the web site should not contain many graphics.

Analysis

The analysis phase is a process for structuring information (Forsythe, Grose, Ratner, 1998). This process entails identifying user tasks, determining valuable material, and organizing information. Identifying user tasks is a procedure for gathering user tasks and actions that are aligned with the goal of the web site (Forsythe, Grose, Ratner, 1998). Some examples are contacting associates, soliciting money and advertising. The process of determining valuable information involves scrutinizing the content of a web site to prevent the publication of useless information (Forsythe, Grose, Ratner, 1998).

During the phase of organizing information, a structure is developed from the mental models of prospective web site users (Forsythe, Grose, Ratner, 1998). The structure incorporates the items web site users frequently use on the web and their method of associating items they encounter on the web (Forsythe, Grose, 1999). A mental model is the hierarchical structure a person uses to arrange learned information (Forsythe, Grose, 1999). One tool used to collect a person's mental model is a Q sort. The Q sort consists of 3 x 5 cards, each containing a description of a tool or task. A person
categorizes the 3 x 5 card into groups that characterize a common topic. After the categories are created, the groups that are formed from the Q sort indicate a person's mental model of the information on the index cards and their method of associating the information on the index cards (Forsythe, Grose, 1999).

In addition to using the Q sort to structure a web site, surveys are used to gain additional information. A survey may be used to obtain the frequency a person utilizes the items on the index cards or performs various tasks (Forsythe, Grose, 1999). This task is accomplished by querying a person for their rating of the topics and tools that were used in the Q card sort. The scale for rating the topics and tools should compare and rank the topics and tools (Forsythe, Grose, 1999). After the tasks and tools are rated, the tasks and tools with the highest ratings are placed in a group and labeled as the most frequently used items. The items in this group represent items that the user should have the ability to easily access from the web site (Forsythe, Grose, 1999).

HUMAN FACTORS ENGINEERS WEB PAGE PRINCIPLES

Human Factors Engineers Web Page Principles are guidelines for creating orderly and user friendly web pages (Forsythe, Grose, Ratner, 1998). These guidelines are categorized into two groups. There are general principles and interactive principles. The general principle category is a collection of principles that are used to structure web sites that advertise and exhibit information (Forsythe, Grose, Ratner, 1998). An example of a web page that exhibits general principles is "www.sandia.gov." (Figure 1).

Figure 1: www.sandia.gov

The Interactive category is a collection of principles that are used to structure web pages that relay information to and retrieve information from web page users (Forsythe, Grose, Ratner, 1998). Some common interactive web pages that exemplify interactive principles are the Sandia Time Card Web Page and the Sandia directory (Figure 2).
The hypertext Markup Language (HTML) is a multiple platform scripting language used to format web page graphics and texts (Holzschlag, 1988). Multiple platform scripting languages are executed on various user interfaces such as Windows NT, DOS and Windows 95 or 3.1, Macintosh, UNIX, VMS, Sun Microsystems or LINUX. HTML is a good language to use for designing web pages because the popular and most commonly used browser is HTML compatible. The basic HTML components that are used to format graphics and text are tags, attributes, and values (Holzschlag, 1988).

HTML tags, also referred to as elements, are used to structure web pages. These elements structure web pages through following two basic rules. The first rule is all tags are placed between less than and greater than signs “<HTML>” (Holzschlag, 1988). The second rule is that a closing tag should follow an opening tag “</HTML>” (Holzschlag, 1988). However there are exceptions to this rule. Some tag such as “<IMG>” are never accompanied by a closing tag (Holzschlag, 1988). Additional examples of tags are TITLE, HEAD, BODY, H1 and p in Figure 3. An attribute is used to enliven web pages (Holzschlag, 1988). Some examples of attributes are “bgcolor” and “text” which are in Figure 3. These attributes enliven web pages by adding color to the background and to the text of the web page. Values are objects used to define attributes (Holzschlag, 1988). Some examples of values are “#FFFFFF” and “#000000” in Figure 3. The value of “#FFFFFF” defines the color white and the value of “#000000” defines the color black.

```html
<HTML>
<HEAD>
<TITLE> Model Program </TITLE>
</HEAD>
<BODY bgcolor="#FFFFFF" text="#000000">
<H1> Model Header </H1>
<p>Text for a paragraph</p>
</BODY>
</HTML>
```

Figure 3: Simple HTML code for a paragraph with black text and a white background.
GENERAL USABILITY TESTING

Usability testing is used to evaluate user interfaces by measuring the time to complete tasks, the types of mistakes made by a user interacting with the user interface, and the user's satisfaction with the web site (Forsythe, Grose, 1999). The steps involved in conducting a usability test include selecting a random sample of subjects to perform the test, timing subjects while they perform the test, counting the number of mistakes made by the subject during the test, and evaluating the subjective opinion of the user upon completing the usability test (Forsythe, Grose, Ratner, 1998). The process of selecting a subject requires the test administrator to identify subjects who represent the pool of people who will use the user interface. Timing the subject will produce a measurement of the time span for completing a task using the user interface. The procedure of counting the number of mistakes made by a subject involves tallying the incorrect actions the subject performs during the usability test. Also the errors indicate where the user interface does not correspond with users' mental models and consequently is not intuitive. The subjects' satisfaction with a web site is measured by evaluating users' opinions of the web site.

RESEARCH

The Human Factors Web Page Research led to the construction of a web site for the human factors engineers in organization 12323 of Sandia National Laboratories. The construction of the web site involved four procedures. These procedures were task analysis, structuring, coding, and usability testing.

TASK ANALYSIS

Through performing task analysis on the human factors engineers, the structure of their mental models of the information they use on the web and the information they frequently encounter were inferred. The structure was developed as result of implementing the task analysis planning phase and analysis phase.

Planning

During the planning phase the purpose of the web site was established and user characteristics were obtained by interviewing human factors engineers. The purpose that was established through interviews was "the web site should access web pages that human factors engineers frequently use or assists human factors engineers with their daily activities." This purpose should reduce the time human factors engineers expend in searching for information on the WWW. After obtaining the purpose of the web site the characteristics of the user environment were obtained. The characteristics are listed in Table 4.
Browser: Netscape Navigator 3.0™
Internet Connection: T1 cable
Network of Web site: Intranet with Internet access

Table 4: Usage characteristics

Since the most common browser used by the human factors engineers is Netscape Navigator 3.0 the web pages should be coded to run on Netscape Browsers. Because the computer that will display the web site for human factors engineers is connected to the Internet with a T100 cable the web site can feature many graphics. Since the web site is on an intranet, the web site should focus on the business needs of Sandia National Laboratory.

Analysis

The analysis phase consisted of three procedures; task identification, information content collection, and task organization. During the task identification phase, human factors engineer tasks, web page bookmarks, job related web sites and activities were identified. After the task identification phase was completed the information content phase was initiated. During the informational content phase, items collected during the task identification stage were scrutinized for their relevance to human factors engineer jobs. If they did not relate to human factors engineers' goal for the web site they were eliminated from the list.

The organization stage involved surveying the human factors engineers for the frequency they utilized tools collected during task identification. The scale that was used to measure the rate of usage was an integer scale of numbers from one to five. In the scale, one symbolized an item was never used by the engineers, two symbolized an item was used less than once a month, three symbolized an item was used once a month, four symbolized an item was used once a week, and five symbolized an item was used everyday.

In addition to using a survey to collect additional information, a Q sort was utilized to categorize information that remained after the information content phase. The items were each placed on 3 x 5 cards and sorted by the human factors engineers. As a result of the Q sort, the tasks that were established after the information collection were categorized and the resulting categories were titled. After completing the survey and the Q sort, a structure was created using the results of the Q Sort and Survey. A diagram of the structure is in Figure 5. The items on the left side of the structure are the items that represent the items human factors engineers use most frequently and the items on the right branch of the structure represent the categories that were most commonly grouped together by the human factors engineers.
Coding Phase

During the coding phase the structure in Figure 5 was used to model the web site for human factors engineers. The web site was modeled by representing nodes in the structure with web pages. The web site consists of a homepage (Figure 6) and several links from the homepage. The homepage represents the structure in Figure 5 and the pages that are linked from the homepages represent the leaves in the structure in Figure 5. The home page contains two frames. These frames are the Panel frame and the display frame. The Panel frame is used to list the links that are most frequently visited by the human factors engineers. This frame is displayed at the top of any web page linked from the human factors engineer web site.

Figure 6: Human Factors Engineers Web Site Homepage.
The display frame contains titles that serve as links to web pages that contain categorized items. These titles are:

- Search Engines,
- Professional Societies,
- Location Information,
- Department 12323 or Organization 12300,
- General Sandia National Laboratories Information,
- Miscellaneous,
- Standards & Guidelines,
- Information Human Factors,
- Literature
- Catalogue and Online Stores.

**Usability Testing**

The purpose of using usability testing during the research was to determine if the human factors engineers web site was intuitive, and to obtain ideas for improving the web page. The testing was accomplished by asking a test subject to perform a task with the web site. Some of these tasks are:

- Find California ES&H document system
- Query case numbers
- Find information for handling chemicals

While the subject performed the task, the test administrator observed and recorded when the subject became frustrated or confused. If performing the task with the web site was not intuitive or a task revealed a flaw in the usability of the web site, the task was recorded along with the clues that revealed the subject was confused or frustrated with the web site. Also, the subject was asked to explain the events that were difficult to perform and to offer suggestions for improving the web site. The reasons the subject said he experienced difficulty completing the test were the titles in the display frames did not properly describe their categories and he did not read all of the categories on the web page. The suggestion the subject made to improve the intuitiveness of the web page was to include a description of the titles on the web page. Some other suggestions for improving the web site were to make all the links in the web site active and increase the font size of the titles on the homepage.
CONCLUSION

In conclusion much information on the WWW is not intuitively structured for the Human Factors Engineers in department 12323 of Sandia National Laboratories. As a result these engineers unnecessarily expend time finding information on the web that relates to human factors engineering. In order for these engineers to find information on the WWW more efficiently, the web site for human factors engineers was developed. The web site allows the engineers to efficiently find information on the web because the web site is designed to satisfy their unique requirements and accommodate their mental models. Unfortunately more research needs to be performed to make the web page more usable because the usability test signified the web site has opportunities for improvements.

FUTURE RESEARCH

In the future the web site for the human factors engineers at Sandia National Laboratories will become more usable and intuitive. This goal will be accomplished by adding descriptions next to the title in the display frame of the home page, modifying the titles in the display frame to be more descriptive, and performing usability tests. In addition the font size of the titles on the home will be enlarged and all titles will become active.

WORKS CITED


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