

Color Your Website: Use of Colors on the Web

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Abstract. In spite of the wealth of information available on designing international user interfaces, it is not easy for web designers to acquire a deep understanding of culturally appropriate user interface design. There is a lack of tools that assist web developers in creating culturally appropriate user interfaces. In our paper we present an empirical study that identifies culture-specific web interface design elements for a number of countries using semi-automated approach, in order to incorporate the results into a cultural interface design advisor tool. The paper presents results of the pilot study on web design color preferences for a number of countries. Results show that along with ten colors that are used universally in website design for all countries studied, country-specific color palettes could be identified. Examples of these “preferred” palettes are presented in the paper along with suggestions on how designers can work with such palettes creating culturally appropriate websites.

Keywords: Color preferences, color theory, cultural user interface, usability.

1 Introduction

The need for culturally appropriate interface design for e-commerce applications is emphasized by many researchers [1], [2], [3]. Specifically, it is noted that the “culturability”[4], a combination of culture and usability in Web design, directly impacts on the user’s perception of credibility and trustworthiness of websites [5], [6]. A culturally sensitive e-commerce framework [7] lists cultural appeal as one of the four important factors impacting on sustainability of e-commerce activity, along with economic appeal, usability and general attitude towards e-commerce; thus reflecting the importance of cultural factors in e-commerce applications.

Some theoretical models developed by researchers for managing the “subjective” aspects of cross-cultural interface design include cultural dimension (n-factor) models [8], [9], [10], [11], cultural markers model [12], and cultural attractor model [13]. Within their framework model, Barber and Badre [4] provide a detailed list of cultural markers corresponding to web design elements such as color, spatial organization, fonts, shapes, icons, metaphors, geography, language, flags, sounds, motion, preferences for text vs. graphics, directionality of how language is written (left vs. right), help features and navigation tools. Smith et al. [13] define cultural design elements as “cultural attractors”, and list a smaller number of them: colors, color combinations, banner adverts, trust signs, use of metaphor, language cues and navigation controls. Sun [14], in

turn, focuses on only four major categories of cultural markers: language, visuals, colors and page layout.

Empirical studies focused on evaluating the influence of cultural markers on user performance and acceptance of websites found some evidence of user preference for websites with cultural markers from their own cultures [15], improved performance for users on their local sites [16], or some cultural differences between websites for different countries [17], [14]. Based on these studies, it appears that it is easier to “map” the cultural markers directly into culturally appropriate design elements for a website [13]; therefore, in our cultural web user interface study we chose to use the cultural markers approach.

2 Cultural Web User Interface Study

The study investigates the usage of specific visual cultural markers for website design in a number of countries, in order to incorporate the results into a cultural interface design advisor tool. For the purpose of this study, cultural markers are defined as “interface design elements and features that are prevalent, and possibly preferred, within a particular cultural group”[18]. The visual cultural markers we are investigating are colors, font usage, number of images, and layout of the webpage.

This study is carried out via an automated “cultural audit” of a large number of websites from different countries. A Cultural Web Spider (Web crawler) tool, designed to extract information on culture specific Web page design elements (cultural markers) from the HTML and CSS code of websites for a particular country domain (eg: .ca for Canada, .fr for France, .jp for Japan, etc.) is used in the study [19]. The Cultural Web Spider application (CWS) utilizes Google SOAP APIs Web services [20] to search for particular cultural markers on web pages of top ranked websites for a country domain.

When using a Web Crawler to collect data for further analysis, it is important to make a proper choice of methodology for this survey, and , especially, of websites for data collection [21]. We are collecting data on the top ranked (popular) websites for a particular country domain in the Google index, thus we are capturing a representative sample of cultural design preferences for a particular country. In addition to this, Google API allows further restricting the search to country domain websites written in a particular language. In this way, we were able to limit the automated “cultural audit”, of top ranked country specific domain websites, to sites written in the country’s official language (e.g. Russian for Russia, French for France, Portuguese for Brazil, etc.) and assure reliability of our cultural study results. The Web crawler tool collects information on the color usage (e.g. page background colors, table background colors, font colors, etc.), font usage, and number of images on a website. This information is saved in a cultural database and is available for further statistical analysis and visualization.

To investigate the appropriateness of our approach, and the functionality and usefulness of the cultural analysis tools we are developing, we conducted a pilot study focused on Web design color preferences for 26 countries around the globe.

3 Color on the Web

Color plays an important role in different cultures throughout the history, and the choice of color plays a vital role in design, advertising and marketing [22, 23]. Some researchers suggest that certain colors have symbolic connotations in different countries, for example that green is preferred color in Islamic countries, red is preferred color in China and black is preferred in US, although has some unfavorable connotations in Asia, Latin America and Europe [24]. Others [25] connect colors with feelings, especially in advertising. Recent research study by Chattopadhyay et al. [24] suggests that most aspects of color (hue) preference are likely to be culturally universal, in fact, in their research they found that blue was the most preferred hue in every culture.

In our study on cultural preferences in website design for a number of countries we wanted to explore, in addition to other cultural markers, color preferences expressed by web designers in choosing colors for their websites, including colors chosen for webpage background, table background, graphics, text, imaging, etc. The underlying assumption is that the Internet, as a medium of communication, presents an opportunity for designers to truly express their color choices since the choice of colors for webpage is not constrained by cost or technical limitations that are frequently imposed when working with the print media.

3.1 Web Color Usage Pilot Study

The color usage pilot study investigates color use on the Web by studying a large number (from 900 to about 1000) of county-specific websites per each of 26 countries located in Africa, Asia, Europe, Latin America, North America, and Oceania. The list of the countries studied is presented in Table 1.

The first stage of the study involved web crawling with CWS tool and extraction of culture-specific information from HTML code by searching top-ranked (the most popular) pages in the Google index for a particular country and language. An analysis tool was developed to analyze all the information collected in the database and produce between countries comparisons for different cultural markers such as color usage, font usage, the number of images used on the page, usage of style sheets, etc. For the second stage of our study, the results collected by the CWS tool are statistically analyzed and visualized using a CWS visualization tool. This tool visualizes the results of analysis on a color usage in different countries and present most frequently used RGB colors for a particular country as color palettes [19].

3.2 Identification of Colors Specified in HTML and CSS Code

Designers have at their disposal a palette of about 16.7 million colors based on HTML RGB color code to create their interface designs. Therefore, the main inconvenience of using the CWS visualization tool is that the tool could not possibly show all the RGB design colors used in a convenient and user friendly format.

Table 1. List of countries for the pilot color study

Country	Language	Country	Language
Australia	English	Italy	Italian
Belgium	French	Japan	Japanese
Brazil	Portuguese	Korea	Korean
Canada	English, French	Mexico	Spanish
China	Chinese	New Zealand	English
Denmark	Danish	Norway	Norwegian
Egypt	Arabic	Poland	Polish
Finland	Finnish	Russia	Russian
France	French	Saudi Arabia	Arabic
Germany	German	Spain	Spanish
India	English	Sweden	Swedish
Indonesia	Indonesian	United Kingdom	English
Ireland	English	United States of America	English

To resolve this, we developed a color calibration tool that incorporates a proprietary color classification algorithm. This tool enables us to categorize all the colors discovered in our search into a manageable number of color categories corresponding to the user friendly “artistic” palette based on a well known “color wheel” palette of twelve hues [26]. The color calibration tool functionality allows us to manually adjust chosen color categories, if needed. Our “artistic” palette of 53 colors includes such intuitive and easy to understand color categories as white, black, three shades of gray (dark gray, gray and light gray), and four shades for each color hue such as dark blue, light blue, medium blue and shaded blue for blue; light yellow, medium yellow, dark yellow and shaded yellow for yellow, etc. (see Figure 1).

By using the color calibration tool for color clustering, we were able to analyze the color usage data harvested by the Cultural Web Spider more efficiently and visualize the results via an HTML Color Analyzer. The HTML Color Analyzer represents color information we collected as a pie chart color palette for a particular country and the results of this work are presented elsewhere [27].

In the process of further data analysis we have discovered limitations imposed by the nature of the automated Web “harvesting” process. For example, for any website that has images and graphics as most prominent design elements, image color information is lost in the automated cultural analysis using an HTML analyzer, since image color information is not contained in the HTML or CSS code.

Moreover, an HTML Color Analyzer counts instances of a particular color usage in the HTML code. The number of instances for a particular color does not necessarily gives a true indication of color preferences, since in this case the area of color coverage is not taken into account. For example, multiple usage of a color “dark blue” as a cell background color in the table will result in an overall higher count of “dark blue” color usage, than when the same “dark blue” color is used as a background color for the entire table (despite the fact that the resulting visual effect could be the same).

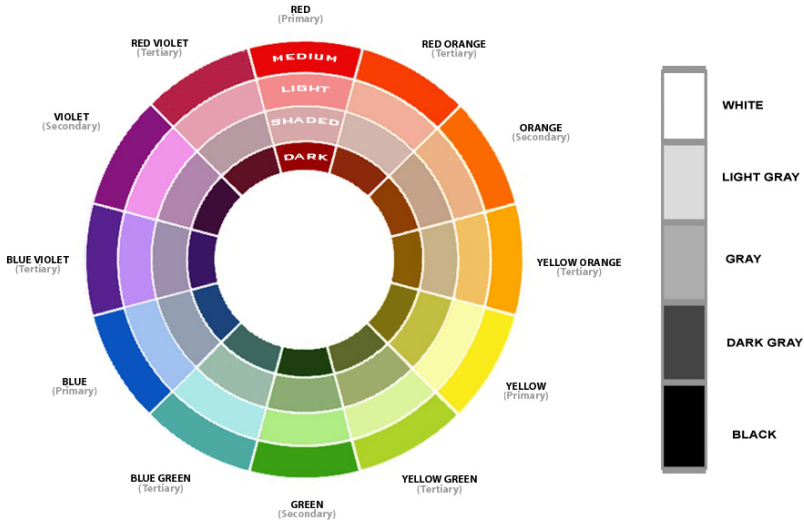


Fig. 1. “Artistic” color wheel

3.3 Finding Predominantly Used Colors Based on Webpage Snapshots

To overcome this apparent shortcoming of our data collection and analysis efforts, we developed another application for color analysis – the Image Color Analyzer. This application enables capturing a “snapshot” image of the webpage under review and analyzing color information in this image. This approach provides an opportunity to automatically analyze color usage on a large number of websites, and capture and

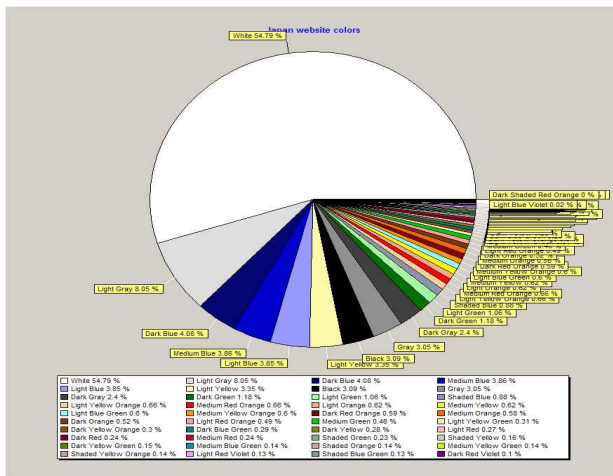


Fig. 2. Image Color Analyzer results: color palette for Japan

analyze a “visual appearance” of the webpage. This method provides us with an advantage in comparison with a labor consuming visual color analysis on the same number of websites (about 1000!) conducted manually by a researcher.

Image Color Analyzer tool permits us to precisely measure the relative coverage of different colors on the webpage of interest in percentage of the total webpage area. Color Analyzer also allows visualizing color usage and producing country-specific color usage pie charts, based on the color calibration scheme chosen via the color calibration tool. A color usage chart for Japanese websites produced by the Image Color Analyzer is presented in Figure 2. Similar color charts were produced for all countries previously studied using an HTML analyzer.

4 Study Results

We conducted our netnographic [28] color usage pilot study on a large number of website for a certain locale and harvested cultural markers usage data on the top ranked websites for a particular locale. We believe that the choice of colors, to a certain degree, reflects local users’ preference for a particular color or color combinations on these “popular” local websites.

4.1 International Color Palette

In order to derive country-specific color palettes for fifteen out of 26 countries we studied, results obtained by utilizing both tools, the HTML Color Analyzer and the Image Color Analyzer, were examined using the following approach. We chose the sixteen most commonly used colors for a particular country, based on results obtained by the Image Color Analyzer. Thus, based on analysis of “snapshots” of web pages, we created country-specific color palettes. After this, we cross referenced these palettes with the results obtained by using the HTML analyzer. In this way we could eliminate colors that might be present in images on Web pages, but do not correspond to color preferences we identified though the HTML analyzer. This cross-referencing process helped us to choose a country palette of colors with both, a high coverage area and a high number of usage instances, verifying country-specific color preferences obtained by using each of the tools separately.

Results of our color usage analysis for the fifteen countries showed that some colors are commonly and preferentially used across all countries studied [29]. These colors include white, black, all shades of gray, all shades of blue and a light yellow color. We named this color palette the “international colors palette” (Figure 3).

4.2 Country-Specific Color Palettes

As a next step, we continued with further data analysis in order to single out country-specific color preference. As a result, we identified two to four additional “country-specific” colors by cross-referencing data obtained via HTML analysis and webpage snapshot analysis. The results for fifteen countries studied are presented elsewhere [29].

white	
light gray	
gray	
dark gray	
black	
shaded blue	
dark blue	
medium blue	
light blue	
light yellow	

Fig. 3. “International” color palette

In order to further expand the palette of country-specific colors for different countries, we chose to base our color usage recommendations on the range of preferred colors obtained through image analysis of webpage snapshots using the Color Image Analyzer. We believe that they represent the overall visual appearance of country-specific websites more precisely than the color information contained in HTML code. During the data analysis process, we removed the “international” colors from the color palettes obtained via Image color analysis of country-specific websites and obtained country-specific palettes presented with pie charts with relative percentage of the coverage area identified. An example of a country specific color palette for Japan is presented in Figure 4. Similar palettes are prepared for all 26 countries involved in the study.

As a next step in our investigation, we looked at the process of how these “country-specific” color palettes could be used to develop recommendations on country-specific color combinations for culturally appropriate interface design. Since our color palettes are based on the Johannes Itten’s twelve-point color circle, we suggest that the process steps could follow the color theory approach to choosing colors from the color circle for determining complementary color pairs and harmonious color triads [26]. There are other relevant sources of information available for designers for choosing appropriate color combinations [30, 31], as well as some software resources such as ColorWheel software [32]. Design color decisions could be also supported by the tools that present information on “historical” meaning of particular colors [22, 23, 33, 34].

4.3 An Example: Color Combinations for Japan

As an example, we suggest how one can choose appropriate color combinations for Japan, based on the color palette in Figure 4 and utilizing a color theory. As seen from Figure 4, the following colors are prevalent in the country-specific palette for Japan: green (21.5% in total for dark, light and medium green), red orange (13.7% in total), orange (13.6% in total) and yellow orange (12.7% in total). In addition to these colors, yellow has significant presence in the palette of colors used in Japan (medium and dark yellow in total give 7.2 % and light yellow is popular as well as seen from Figure 2).

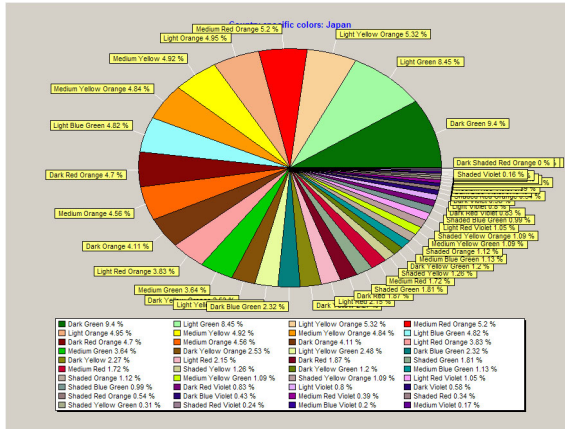


Fig. 4. “Country-specific” color palette for Japan

Based on the color theory, the designer will look for the appropriate color combinations (schemes) that could be used with these dominant colors. Such color schemes to chose from could be complementary, split complementary, analogous, etc. Complementary color pairs are any two colors which are diametrically opposite one another in the color wheel. Split complementary scheme could be achieved by substituting for one color of a complementary pair the two colors that lie on either side of the color wheel. For example, to harmonize green, the designer will choose a pair of colors such as red-orange and red-violet (or either one of them) to form the triple or pair harmony with the predominant green color. In the case of Japan, since red orange is predominantly used, it might be appropriate to use this color with green. To expand the analysis, based on the color wheel for Japan, an analogous color scheme that uses colors that are adjacent to each other on the color wheel would be yellow, yellow orange, orange and red orange.

It is important to notice that in our approach we do not restrict the choice of design colors, for example, a red orange color category contains a wide range of red orange hues to choose from. This is true for all other color categories.

5 Conclusion

The cultural interface design study investigates the usage of specific cultural markers for website design in a number of countries, in order to incorporate the results into a cultural interface design advisor tool. In particular, a pilot color study investigates usage of color for website design in different countries.

Results of the study show that, along with some colors (hues) used universally across the multitude of cultures, there are some preferred country-specific color palettes that could be used by web designers to create culturally appropriate web interfaces. The beneficial effect of utilising these palettes of colors for web design needs to be futher evaluated by conducting usability testing with end users for different locales.

An additional outcome of this research study is that we developed a suite of tools that could be used by researchers for conducting ethnographic and cultural studies on the Internet and by marketing intelligence companies to identify cultural trends for advertising and marketing purposes. The results of the pilot color usage study confirmed the feasibility of using software tools for quantitative and qualitative research on the cultural “look and feel” on the Internet.

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