

Improving Web Color using Color Scheme Assessment Tool (COSAT)

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ABSTRACT

Nowadays, usability of a user interface becomes extraordinary important. We cannot underestimate the measuring of usability because it can reveal the qualities of the product in term of its functionality, which usually arises during the design phase. Therefore, usability is crucial to be considered when developing a system. Color has an important role to increase the usability of a web page. The use of proper color on interface design can greatly enhance the user attention which will help to enhance the usability of software. According to the existing web design guidelines, color combination, color contrast and color position are the three main features to be considered in web color design. From the existing usability tools on web color checking, we found a research gap on the usability tools which reflect to the three main features of color consideration in web page. Until now, there is no tool exists that combined these main features. Thus, this paper is aimed to develop a usability tool namely Color Scheme Assessment Tool (COSAT) that follows the guidelines of color combination, color contrast and color position.

INTRODUCTION

World Wide Web (WWW) is a hypertext documents that can access through internet over the world. Nowadays people intend to use web page to promote products or services to international audiences. A web page is specialized device between a web maker and a web client. Web maker and web client share their feeling and convey through a web.

The usability of web pages is the key to make the web pages easy to use and enjoyable. In addition, keeping it simple will help to enhance the effectiveness in focusing on end-user attention. Using suitable mixed or combination

of contrasting colors can help catching the visitor attention on web pages. Color plays a major role in increasing the usability in human life. For example system on a TV remote control, every button is highlighted with different color so that the user can navigate easily from one area to another effectively (Ahmad, A, 2012).

USABILITY ON WEB PAGE

The usability and the ease of use of a web site are the integral part of the success specially when the web page become more and more interactive, quality and packed with features. According to Jacob Nielsen (2012), the usability

of a web page is important to estimate how the efficient user interface is. Good usability is the main key of the quality of any business websites, while poor usability of the websites is one of the major causes of the failure (Becker et al, 2001). If a web page is difficult to use, hard to navigate through, not readable and not understandable, the visitor will lose interest and leave the page. Shacklett () claimed that, "28% visitor of web page feel frustration and 6% of the visitor leave the web page say "they won't return to the web page".

COLOR AND USABILITY

Color is one of the crucial elements in web design. Therefore, developing a successful web page requires careful consideration of the color on attention and perceived usability. The use of proper color interface designing can greatly enhance user attention and the usability of software. Color in interfaces is a typically a usability issue and powerful phenomenon that can influence human beings. According to Satyendra Singh (2011), customer takes more than 90 seconds to decide about a product. 62-90% of that opinion is determined by the color of the product.

Nowadays, biggest multinationals Companies invest millions of dollars to choose suitable color for the pressing and marking of their items. As the result, use of proper color in designing interface can greatly enhance user attention thus enhance usability of software. For example, Shenkman et al (2000) examined users' first impression on web site and they found that the best predictor for the overall judgment by typical users of a website was its beauty. To create ease of use web pages, Jacob Nielsen's (2012), recommend usability guidelines for determining the usability of the web page which are quality of learnability, efficiency, memorability, errors and customer satisfaction.

- Learnability: To identify how easy the user interacts with the design to accomplish the basic task.
- Efficiency: To identify how quickly the user learns the design to perform the task.
- Memorability: To identify how quickly the user performs the task after a period not using it.
- Errors: To identify how many error the user produces to accomplish the task and solves the error.
- Satisfaction: To identify the effectiveness and efficiency of the web page design.

In addition, according to McLaughlin et al (1999), usability can be divided into six related components that are:

- Checkability: To identify the quality of input and output data
- Confidence: To identify the confident level of user when interacting with the system
- Control: To identify the capability of user to go anywhere with the true information
- Ease of Use: To identify the effectiveness of the system
- Speed: To identify the efficiency of the system to perform the task
- Understanding: To identify the level of user understanding

Every component plays different roles to maintain the effectiveness of the web page, (Jacob Nielsen, 2012). In general, ease of use or usability of web pages is an important aspect of web design. Usability of a web page is the key to make it easy to use and enjoyable. Keeping it simple has been proved to be effective in focusing end-user attention. Table 1, shows the relationship between color selection and usability.

Table 1; Relationship between Right Color Selections with Usability

Researcher(s)	Usability Component	Summary of studies
Chan Jean Lee	Satisfaction and Confident	Customer usually buys the product depends on the color when purchasing, color is related to emotional and aesthetic to customer. The combination in designing brands to make customer confident in decision making.
Shneiderman, 1992	Efficiency	Limiting the number of colors. Overuse of color when designing web page can be counterproductive and obscure information.

COLOR FACTOR AFFECTING DESIGNING WEB PAGE

Color is an important element when designing a good web page. According to Nicolas Arellano (2012), customer will decide within 90 seconds

on the acceptability of a product, and much of the decision is based on color. 85% of public users place color as a primary reason for them to buy a particular product and selection of best color increases brand recognition by 80%. Creative on the use of color is an effective manner in order to make the web page looks professional and deliver a right message in a right way.

Sometimes, color acts as delivery for some messages. The colors used in a web page will likely influence a user's expectations about the web page. The effectiveness on the right color selection can easily influence visitor. There are a few issues on web design that influences readability and legibility as summarized in Table 2.

Table 2: Issues Influencing Readability and Legibility of Web Color

Researcher (s)	Issues influencing readability and legibility of web color	Description Summary of studies
Kulkarni et al, 2011	Color Mixed or Combination	Certain color combinations make visitor stick or stay on webpage.
Hye-Yeon Lim	Color Contrast	Contrasting colors can guide the visitor attention on the specific page element and sometimes injuring the reader's eyes
Georg Buscher, 2010	Color Position	Arranging important page element on page layout is way to grab user attention and to make user easily to determine the functionality of the web pages

1. Color Mixed or Combination

Color has important roles to control and touch the feel and look of a web page. Mixing or combining a few colors are able to make the web page becomes interesting, looks ugly or invoke emotional responses. Therefore, web designer should follow the guidelines to create a good interface and visual effect in order to ensure visitors enjoying the web experience (Friedman, V, 2008). Complement and recombination of colors represent the relationship with other colors. Complement colors give a vibrant feel when used together. Color combination exploration has shown that choosing the right color combination is very important, not just for legibility but also for long reading durations

(Hall, R.H, and Hanna, P, 2004). Table 3 shows the feedback of color combination on web legibility from researcher's point of view.

Table 3: Feedback of Color Combination on Web Legibility

Researcher	Summary of studies	Result	
		Most preferred color	Least preferred color
Jakob Nielsen, 2000	Color on the web pages is aimed to maximize readability. Color enhances the aesthetics of the web page, more affected to user.	Black text and white background	White text and black background
Shien and Lin, 2000	Comparing the impact of twelve different color combinations that consider in different type of screen type (LCD vs CRT)	Blue on Yellow	Purple on red
Lin, 2003	Conducting three experiments where chromatic colors is more systematically varied which increasing readability performance		Grey and luminance
Kelly and Gregory, 2011	Combination of 702 color for foreground (text) with background	Dark text on light background and or black foreground with white background is most preferred	Cyan on magenta and green on red

2. Color Contrast

Colors also have a functional impact on readability, legibility, eyestrain and ability to attract attention. The issue is to create the background and text with enough contrast to make the content legible without injuring the reader's eyes (Cannon, 2012). Good contrast on the web pages helps to create a smooth visual experience for all users, by improving text legibility and protecting users from tiredness

especially for older users or users with weaker eyesight (Krischer, C, 2010). The most apparent example of contrast is an effective selection of background and text color, as shown below in Figure 1:

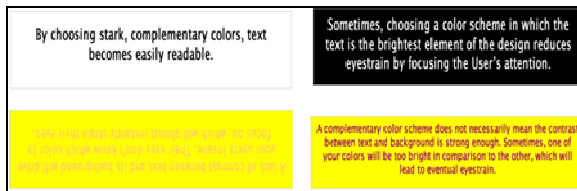


Figure I: Selection of Background and Text Color

3. Color Position

Aesthetic design is an important phase in developing good user interface (Nielsen, J, 2000). The principle was bringing out the important rules on development, which are use of color and use of content. Colors are great elements to let the users focus on particular area on a screen. Choosing right color at right position is important factor to design a good interface.

Arranging important page element on page layout and design is a way to grab user attention (Buscher, G, 2004). The arrangements of important navigational element affect site usability due to user expectation. Visitor quickly adapts to an unexpected screen layout even menu to be on the left hand side of the screen (Michailidou, E, 2008). Table 4 shows the feedback of eye tracking on web areas from the researchers' point of view.

TABLE 4: FEEDBACK OF EYE TRACKING ON WEB AREAS

Researcher(s)	Summary of studies	Result
Jay et al, 2006	Examine the arrangement of the web page on standard display make pages easier for sighted people use	The web pages that consist more information need user to spend more time to complete
Yesilade et al, 2008	Identify the relationship between eye tracking and web pages area	Eye tracking shows strong relationship between web page areas. Eye tracking was able to visualize user attention on specified

McCarthy et al, 2004	Navigational element effect on site usability	element Visitor quickly adapts to an unexpected screen layout even menu to be on the left hand side of the screen
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Figure 2; shows the five web page areas used for the analysis of the eye movement data which are header, left column/ Menu, center column/main column and right column/menu and footer (Michailidao, E, 2008)

MODELING COLOR HARMONY

Web design is a combination from several elements; where each element plays important roles to perform or attract audience. Some elements are related to each other to perform some roles, for example, text and background, color and position and so on. Color contrast is visual interest and directs to user attention. Usually, designer uses different colors in order to grab user attention. This is called color combination. Almost all web design consists of header, content area and footer. Every areas represent different function and every function have its own criteria to attract user attention. These three completely different areas should have a clear visual separation. Using the right color at the background is a best way to highlight the different function of header, content area and footer. Meanwhile, arranging the right color at right position is important element to make a web page more organized and systematic while keeping it simple.

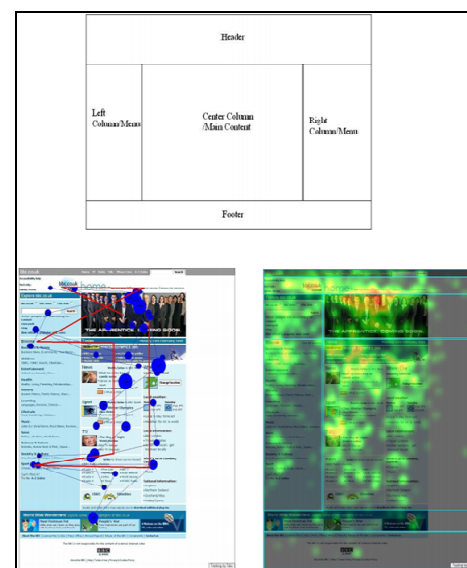


Figure 2: Web Page Areas

1. Color Combination

Color scheme is combination of sets of colors that work well together, often used by designer during the project initiation. Color wheel is a chart representing the relationship between colors. Color harmony is based on geometric relationships on the color wheel known as shapes. Rotation of shapes around color wheel creates limitless color combination. There are several accepted structures for selected right color scheme, which are complementary, analogous and triadic as shown in Figure 3(Session College, 2015).

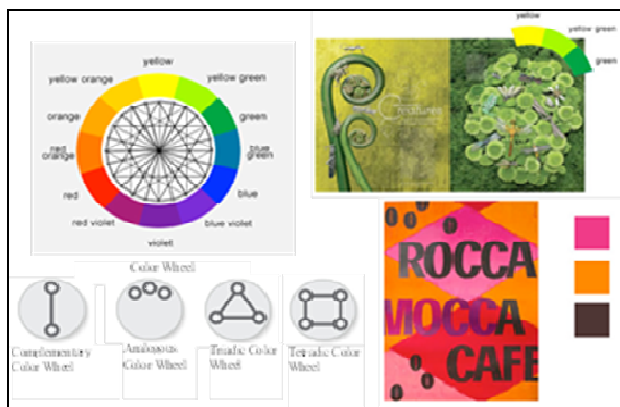


Figure 3: Accepted Structure for Selected Right Color Scheme

2. Color Contrast

The World Wide Web Consortium (W3C) is an international community that produced the Web Content Accessibility (WCAG) guideline, which covers a wide range of recommendations for making web content more accessible. In WCAG, it suggests the suitable requirement for contrast ration and color brightness (W3C, 2015) Luminosity Contrast Ratio by WCAG 2.0 - On color contrast ratio, Web Content Accessibility (WCAG) suggested algorithms for calculate luminosity color contrast. The following calculation shows the color contrast ratio selected for this research.

$$\text{Color Contrast} = \frac{L1 + 0.05}{L2 + 0.05}$$

- L1 is the relative luminance of the lighter of the text or background colors
- L2 is the relative luminance of the darker of the text or background colors

Color Brightness by WCAG 2.0 - On color brightness, Web Content Accessibility (WCAG) suggested algorithms for calculating color brightness.

$$((\text{Red value} \times 299) + (\text{Green value} \times 587) + (\text{Blue value} \times 114)) / 1000$$

- The value for color brightness difference is 125
- The value for color difference is 500

EXISTING COLOR TOOLS COLOR AND USABILITY

In the existing color evaluation tools, there is significant difference of features between one tool and another in terms of color combination, color contrast and color position. Table 6 summarizes the features of the existing tools (Creative Blog, 2015). Looking at the existing tools, there is no tool that has been found so far consists of three-color features, which are important for web page usability. This is a research gap that needs to be filled in for improving web page color.

Table 6: Color Features in the Existing Web Color Tools

Tool	Features		
	Color combination	Color contrast	Color position
Adobe Color CC, 2015	√		
Color Sphere, 2007	√		
Check my color, 2013	√	√	
Contrast-A, 2009	√	√	
Color Spire, 2015	√		√
Color Scheme Designer, 2011	√		√
COSAT, 2015	√	√	√

SOLUTION

To improve web page color, this paper is intended to develop a new usability tool called as Color Scheme Assessment Tool (COSAT). COSAT is a tool that could help web designer or developer to choose appropriate color when designing a web page. It can assist the developers to be aware of the color effects on their web page so that they can quickly improve the selection of the colors. Figure 4 illustrates the COSAT contribution in web development workflow.

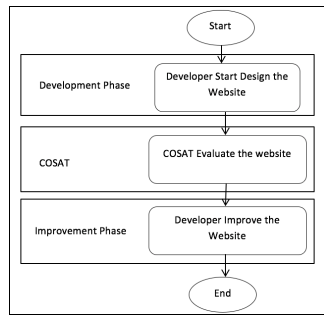


Figure 4: Propose COSAT contribution in web development workflow

For evaluating the web color, COSAT will begin by extracting the color properties used for each web page areas (Refer figure 2). The extracted color properties will then be evaluated against the color guideline as elaborated in section V. Figure 5 illustrates the COSAT workflow.

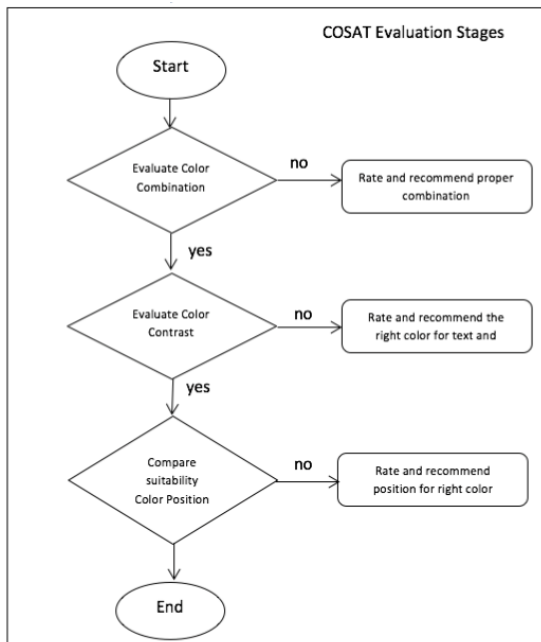


Figure 5: Workflow of the proposed COSAT

COSAT is a proposed tool, which focuses on evaluating and recommending the selection of color combination, color contrast and color position in a web page.

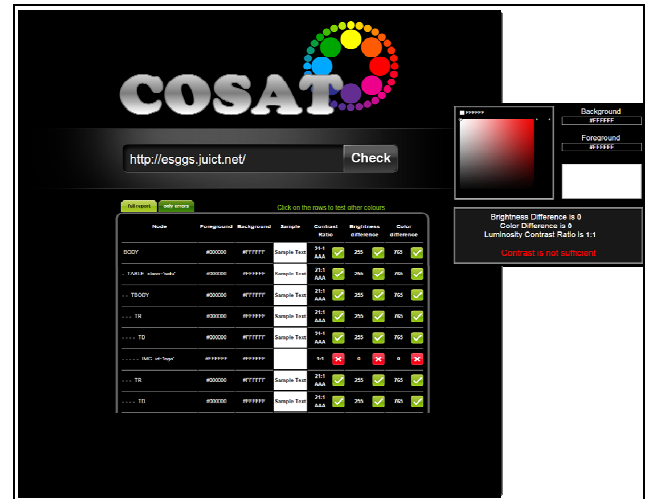


Figure 6: Propose COSAT interface

COSAT EXPECTED RESULT

COSAT is the tool to improve suitability selection of web color in interface designing. COSAT should be able to evaluate and rate the effectiveness of color selection in terms of color contrast, color combination and color position. COSAT will also help developers to detect applied color and validate them after they are done with development phase. COSAT will be implemented by evaluating all color features that all three features are fulfilled. Every stage represents different concepts of evaluation. Rating and recommending proper color will be done based on color scheme to produce the best color selection.

CONCLUSION

Color is an important element in Web page development. Color serves as a communication medium. Colors can catch our attention and will let us respond in view of our own encounters and convictions. Individuals rely on colors for many things. When visitor visit the web pages, the first thing they notice is the color. Color is considered as a major issue because colors have both emotional and psychological impacts. Wrong selection of color can lead to loss of user attention to a web page. According to the literature, three color features: color combination, color position and color contrast are the important elements to produce a good web page. However, these features are still not found in any available usability tools. To fulfill all color features requirement, COSAT will be developed. COSAT will be a free tool that will assist a web designer or web developer on the color selection for their web page.

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