

A Usability Evaluation Method of Dynamic Web Color Design

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Abstract: Color is the first element in web design. In order to cater for people's aesthetics need, more and more dynamic color effects are being used. It is no doubt that rich color brings good user experience. However, using dynamic color inadequately or inordinately will get just the opposite results. So how to grasp the degree of using dynamic web color and evaluate it effectively is a problem being worth inquiring. This paper has expounded the essential meanings and classifications of dynamic web color, and summarized their environments and expression forms. From the point of view of visual selective attention, the elements which would influence the user experience were also extracted. Based on the Fuzzy evaluation method, this article has proposed a usability evaluation method of dynamic web color design. An experiment was carried out to verify this model. Some principles for dynamic web color design were also presented.

Key words: *Dynamic web color, Fuzzy evaluation, usability evaluation, evaluation criteria.*

1. Introduction

Color is the most sensible thing for human vision. Web color could arouse the first visual impression of users'. There have been a lot of successful researches on web color from the static visual angle^{[1][2][3]}, however, few of them has pay attention to its dynamic characteristic. This paper has addressed a new viewpoint of web color, the dynamic web color.

1.1 The definition of dynamic web color

Relative to static color, any web color with dynamic visual effects can be called dynamic web color, including color changes with time or interactive operation, etc.

1.2 Classification of dynamic web color

Dynamic web color can be divided into three types. The first type is color changes with time. In many cases, web color will change spontaneously as time goes on in many different forms. The second type is color changes with interactive operation. As used in common websites, the brightness, the purity quotient, or the hue of navigation color can change to call attention to the current interactive state. The third type is "Simulated dynamic" color formed by Visual illusion. There is a good example of this type, as shown in Akiyoshi's illusion pages,

<http://www.ritsumeai.ac.jp/~akitaoka/index-e.html>. To some extent it is very similar with a basic principle of "like phenomenon" in film production. Of course, it only gives people a visual illusion of "dynamic", but actually it remains static.

1.3 The role of dynamic web color

Dynamic web color plays a great role in both functions and visual effects. It can support interaction process, response to the current operation, playing a role of prompt, attracting attention^{[4] [5]}, guiding sight line, tips, annotation, and reduce visual search features. It can also increase users' interest in the process and satisfaction with that website.

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2. Methods

2.1 The factors influencing the dynamic web color usability

In real situations, there are often a variety of stimulations effecting on the human senses at the same time. But in a specific period of time individual can only process limited stimulation. This processing is the basic meaning of selective attention, which is a concept in cognitive psychology field. From this point of view, we have extracted the elements which would influence the user experience of dynamic web color^[6].

1) The basic attributes of dynamic web color

Dynamic web color often manifested as changes of attributes, including color brightness, hue or saturation, such as alterations of brightness and purity of the same color system, or the use of anti-color, complementary color, and complementary color-to-be. For example, for clicked hyperlinks, colors are dark, low- saturation, to distinguish them from non-clicked ones.

2) The flashing time

The principal factor determining flashing effects is the frequency of blinking. The more rapid of the flashing, the more attention it may attracts. Next is the magnitude of the flashing color. Huge color brightness change means greater attention, and higher visual jumps in pages.

3) The scope of dynamic web color in a page

The scope of dynamic web color in a page means the proportion of it in the entire page. It should not too large, which would cause chaos effect.

4) Responding to users' operation

Web color can also change its attributes corresponding to different interaction states. It is much brighter, more saturated when the mouse moves over, compared to the state of no operation.

5) External formation factors

When the color of a certain part of the page moves its location, or rotates, its size, or changes its shapes, dynamic color effects can also be formed.

2.2 The evaluation criteria

From the factors described above, we can confirm the evaluation criteria as shown below:

- 1) The basic attributes: The color is reasonable and comfortable (from the viewpoint of its basic attributes).
- 2) Flashing time: The flashing time is appropriate, not too long or too short.
- 3) The scope: The scope of dynamic web color in a page is not too much, which would make chaos.
- 4) Interaction: The color responding to users' operation fits in with the users' habit.

5) External forms: The color external forms are exactly to the right degree, such as the location, size, shapes, rotation, etc.

2.3 The fuzzy usability evaluation method and the experiment

Fuzzy evaluation is an effective multi-factor decision-making method which can make a comprehensive assessment of things affected by many factors [7]. To elaborate the fuzzy usability evaluation method, we have taken an empirical study. We have chosen 20 students to conduct a questionnaire survey about the website <http://www.taobao.com>, including 10 males and 10 females.

3. Results and discussion

We define V as the evaluation factors set: $V = \{V_1, V_2, V_3, V_4, V_5\}$.

That is, $V =$ {the basic attributes, flashing time, the scope, the scope, interaction, external forms}.

Then establish the fuzzy evaluation set: $X = \{X_1, X_2, X_3, X_4\}$.

That is, $X =$ {quite good, good, neutral, bad}.

The results are shown in Table 1:

Table 1 Factor rating

Rate \ Factors	X_1	X_2	X_3	X_4
V_1	0.5	0.2	0.1	0.2
V_2	0.3	0.3	0.3	0.1
V_3	0.2	0.3	0.4	0.1
V_4	0.2	0.2	0.6	0
V_5	0.2	0.2	0.3	0.3

The judging matrix can be confirmed from Table 1:

$$R = \begin{bmatrix} 0.5 & 0.2 & 0.1 & 0.2 \\ 0.3 & 0.3 & 0.3 & 0.1 \\ 0.2 & 0.3 & 0.4 & 0.1 \\ 0.2 & 0.2 & 0.6 & 0 \\ 0.2 & 0.2 & 0.3 & 0.3 \end{bmatrix}$$

The participants have also been asked the important degree order of the five criteria. And the most important one was given five scores. Followed by analogy, the least important one was given one scores. Then we can get another table about how important the five criteria means to the users.

Table 2 Weight rating

Scores \ Factors	5	4	3	2	1	Total scores
V_1	4	5	5	4	2	65
V_2	6	5	5	2	2	71
V_3	3	5	2	5	5	56
V_4	5	2	2	5	6	55
V_5	2	3	6	4	5	53

From table 2, we can determine the weight vector as follows:

$$W = \{0.22 \ 0.24 \ 0.19 \ 0.18 \ 0.17\};$$

A new matrix Y can be got from the fuzzy transformation matrix:

$$Y = W \times R = (0.22 \ 0.24 \ 0.19 \ 0.18 \ 0.17) \times \begin{bmatrix} 0.5 & 0.2 & 0.1 & 0.2 \\ 0.3 & 0.3 & 0.3 & 0.1 \\ 0.2 & 0.3 & 0.4 & 0.1 \\ 0.2 & 0.2 & 0.6 & 0 \\ 0.2 & 0.2 & 0.3 & 0.3 \end{bmatrix} = (0.29 \ 0.24 \ 0.33 \ 0.14)$$

$Y = \{0.29 \ 0.24 \ 0.33 \ 0.14\}$ is already the normalized results.

From this fuzzy usability evaluation method, we can find that about 29 percents of the participants are satisfied with the dynamic color used in this website, marked them “quite good”. The “good” marked rating is 24 percent, and the “Neutral” percent is 33 percent. And about 14 percents of the participants dislike it, marked “bad”. Weighting the five criteria, the second one “Flashing time” is the most important. And the last one “external forms” is the least important.

From the results, there are some design principles for dynamic web color emerged out.

- Flashing scope and frequency of blinking should be in a moderate range. The rhythm of the flashing should not be too fast. No matter where flashes in, it will continue to attract people's attention, thereby it should be kept balance with other elements of the page.
- Do not forget to keep harmony of the whole pages, color should not be excessive, to avoid visual fatigue. To use some certain specific colors, such as the thematic color, is a good choice.
- For dynamic texts, font size, window size, magnitude and frequency should be moderate.
- Pay attention to the relationship between the dynamic color and the background. Always remember that the dynamic effect is under the backdrop of the background, rather than isolated.

4. Conclusion

This paper has expounded the essential meanings and classifications of web color, from a new viewpoint, the dynamic attribute. It has a lot of advantages if used appropriately, both in functional and psychological. However, its visual effects should also be used moderately. Based on the fuzzy evaluation method, this article has proposed a usability evaluation method of dynamic web color. First, some factors influencing the dynamic web color usability were extracted out. Then five evaluation criteria were confirmed. To elaborate the fuzzy usability evaluation method, we have taken an empirical study. The experiment results were analyzed with this method. Some principles for dynamic web color design were also presented at the end.

5. References

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