

## Color combination design on web interfaces

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### ABSTRACT

Color decorations of the web interfaces are discussed. Authors, a parameter called *DBV* that affect the operation of the touch panel interface before was revealed. Therefore, a research for application to the *DBV* color design of the interface of websites was conducted. In the research we investigated the *DBV* of 30 corporate websites. Result of the analysis, the number of colors used in the interface decoration was found that there is a correlation between of the *DBV*. Therefore, the interfaces of the small amount of information simple websites, there is a possibility color design used *DBV* is appropriate. Furthermore, we look at the effect of interface that low *DBV* color design. In the experiment, you get the same operation on the low *DBV* site and high *DBV* site to the subjects. The subjects were looking for the photos you chose at random from the experimental sites. We were measuring the task performance time and impression of operation of subjects. The result of the experiment, there is a significant difference ( $.05 > p > .01$ ) between evaluation value of easiness to understand using high *DBV* colors and evaluation value of easiness to understand when using low *DBV* colors.

### KEYWORDS

coloration, design, interface, web-site

## 1 BACKGROUND

### 1.1 RELATIONSHIP BETWEEN DESIGN OF THE WEB INTERFACE AND OUR SOCIETY

We discuss about color design of web interface. Now, decorative web design appear to be growing. Including illustrations, pictures and icons for interest

of the users is used for many web sites. Also be displayed advertisements in a part of the web page, it has become commonplace. However, at the same time the service through the web, shopping and banking, what more important, such as the election has increased. So, as web interface of which can be quickly and accurately operation, it must be designed. Therefore the authors have been verified through experiments the relationship between the operation and the interface design.

Color is one of the important elements in the interface. Color is commonly known to affect the psychological and physiological people.

For example, you can feel like the taste of the beverage by the package of the color saturation has changed, it has also been reported that the color to be used for interior wall and lighting affects the body and sense of time. If the colors used on the operation screen are different, the operator there from It believed that affected the psychology and physiology of people.

If the colors used on the operation screen are different, the operator from them are considered to psychological and physiological affected. Today the interface of decorative is felt as increasingly, can imagine is that they affect the operation.

### 1.2 COLOR DESIGN OF THE INTERFACE

It has been known, such as those focusing on the readability of characters in a research on the color to be used for the interface. However, few research focusing on the relationship between the color and operation of the decoration. Therefore, in the research of authors far the relation between the color impression and the operation as a decoration to be used for the touch panel operation screen, it has been

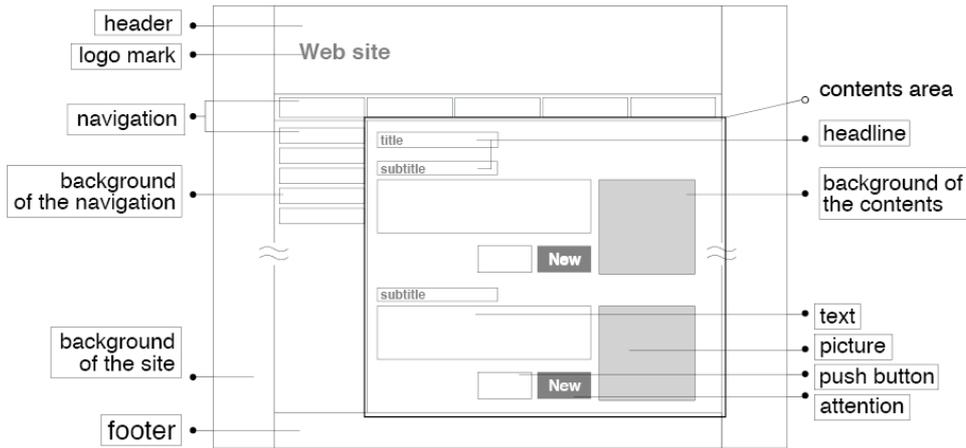


Figure 1 : Elements of web interfaces

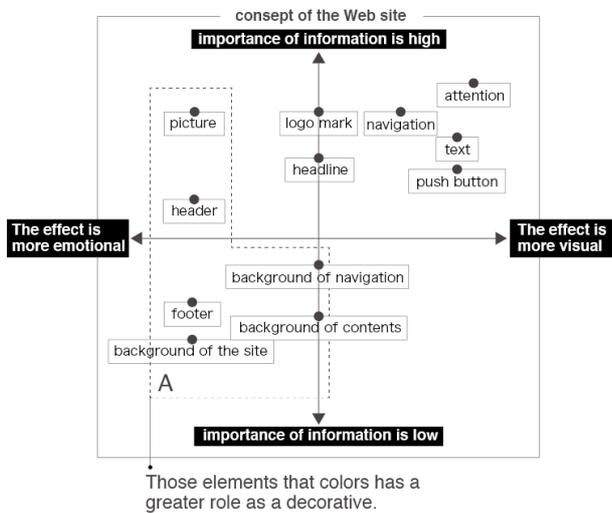


Figure 2 : Mapping of the elements of web interface in accordance with role of its color

verified through the experiment subjects [1][2]. In the experiment, in some experimental screens which includes a combination of colors as decoration on part of the screen, we had working on simple addition challenges to the subjects.

And, the operation time, the number of correct answers, was asked to evaluate the impression received from the screen at the time of operation. The results of the experiment, when the contrast of brightness of colors used for the screen are strong, the low speed and the accuracy of the operation and favorability the operator receives from the screen also

becomes [1][2].

### 1.3 DEFINITION OF THE DBV

The contrast of brightness of colors used in the screen is one of the most important factor of graphic design, and it contributes to a change in an observers emotion and recognition.

The authors have already clarified that speed and accuracy are influenced by contrast of brightness of colors used in a screen when operating a touch panel device. A brightness of color is defined as a number from 0 to 9 in Munsell color system.

When thinking about contrast of coloration, we should consider the differences of brightness among all colors used in the coloration because a coloration consists of some colors. Thus the mean value of the differences of brightness between all combinations used in a coloration is used for representing contrast of the coloration. The mean value is calculated as following:

$$DBV = \frac{\sum_{i=1}^{n-1} \sum_{j=i+1}^n (|b_i - b_j|)}{{}_n C_2}$$

Where  $n$  shows the number of colors used in coloration of a screen,  $b_n$  shows the brightness of  $n$ th color used in the interface.

We call this value *DBV*: Different between Brightness of colors Value in a screen. On the other hand, a mean value of brightness of all colors may be used for representing a brightness of coloration. However, we do not employ this value because the classification by using is incompatible with the classification by *DBV*. In order to apply *DBV* to design of the web interface, authors classify the elements of the web interface.

## 2 CLASSIFICATION OF THE ELEMENTS OF WEB INTERFACE

By using the low *DBV* coloration of the screen, accuracy and preference of operation of the touch panel operation it is found to be higher. However, actual web screens are more complex than the experimental screens. Therefore we consider the role of the elements that make up the web interface.

Psychological action that color give humans split up into two groups [3]. They are visual effects and emotional effect. Visual effects of color helps to identify you to the object. If the object is a character information will be greatly affected by it to the readability. Furthermore, there is also serves to convey the status of the object. On the other hand emotional effect is that you feel like you are cold and warmth and weight and lightness by to see the color. Colors that used in the web interface are determined based on the visual effect and emotional effects in many cases. In addition, by the importance of it of information, elements of designs are dictated. At first classifying elements constituting the web interface. We aggregate the elements that are common to number of web sites to 12. Figure 1 shows these 12 elements. It was mapping colors to use for the web of the screen space on the two axes. Therefore, make visual effects and emotional effect to the axis of the graph. Another axis, it was the importance of information. Figure 2 shows mapping of color of the elements of the web interface.

In particular, Figure 2-A is among the elements that make up the web, was concluded with a large decorative role. So, we investigated the color, such as headers, footers and the background color of the web site of the various companies.

## 3 RESEARCH

Table 1 : Companies that web site has been adopted in the sample and their *DBVs*

brewing company & Beverage manufacturer	DBV	Average of DBV	standard deviation
Suntory Holdings Limited	1.98	5.53	3.07
Kirin Brewery Company, Limited	2.00		
Ito En, Limited	9.60		
Dydo Drinco, Incorporated	7.67		
ASAHI BREWERIES, LTD.	6.40		
food maker & confection company	DBV	Average of DBV	standard deviation
Ezaki Glico Company, Limited	7.55	4.63	1.73
Meiji Seika Kaisha, Limited	2.05		
JAPAN TOBACCO INC.	4.43		
Yamazaki Baking Company, Limited	3.40		
HOUSE FOODS CORPORATION	5.84		
Maruha Nichiro Corporation	3.40		
NH Foods Ltd.	5.72		
finance and insurance industry	DBV	Average of DBV	standard deviation
Japan Post Bank Co., Ltd.	4.40	6.58	1.99
Shinsei Bank, Limited	9.58		
The Dai-ichi Life Insurance Company, Limited	6.43		
Sumitomo Mitsui Banking Corporation	5.78		
SUMITOMO LIFE INSURANCE COMPANY	4.48		
The Bank of Tokyo-Mitsubishi UFJ, Ltd.	8.80		
cosmetics maker	DBV	Average of DBV	standard deviation
ANNASUI	4.40	5.88	2.00
Shiseido Company, Limited	4.80		
L'Occitane International S.A.	8.44		
KOSÉ Corporation	3.63		
Kanebo Cosmetics Inc.	8.13		
electronics company	DBV	Average of DBV	standard deviation
Sony Corporation	9.30	5.93	2.71
Panasonic Corporation	10.64		
TOSHIBA CORPORATION	3.40		
NEC Corporation	5.30		
Fujitsu Limited	3.80		
Sharp Corporation	3.40		
Mitsubishi Electric Corporation	5.70		

Reason for the company web site was surveyed, these concepts are clear, because it is thought to have been reflected in the design. Furthermore, they are also less noise, such as web advertising. Incidentally, Munsell color value was calculated by reference to the value of the references [4].

Table 1 shows company names and industry of web sites that were used as samples and *DBV*. 30 web sites that was the subject of investigation are as follows.

- Brewing company and Beverage manufacturer : 5 sites

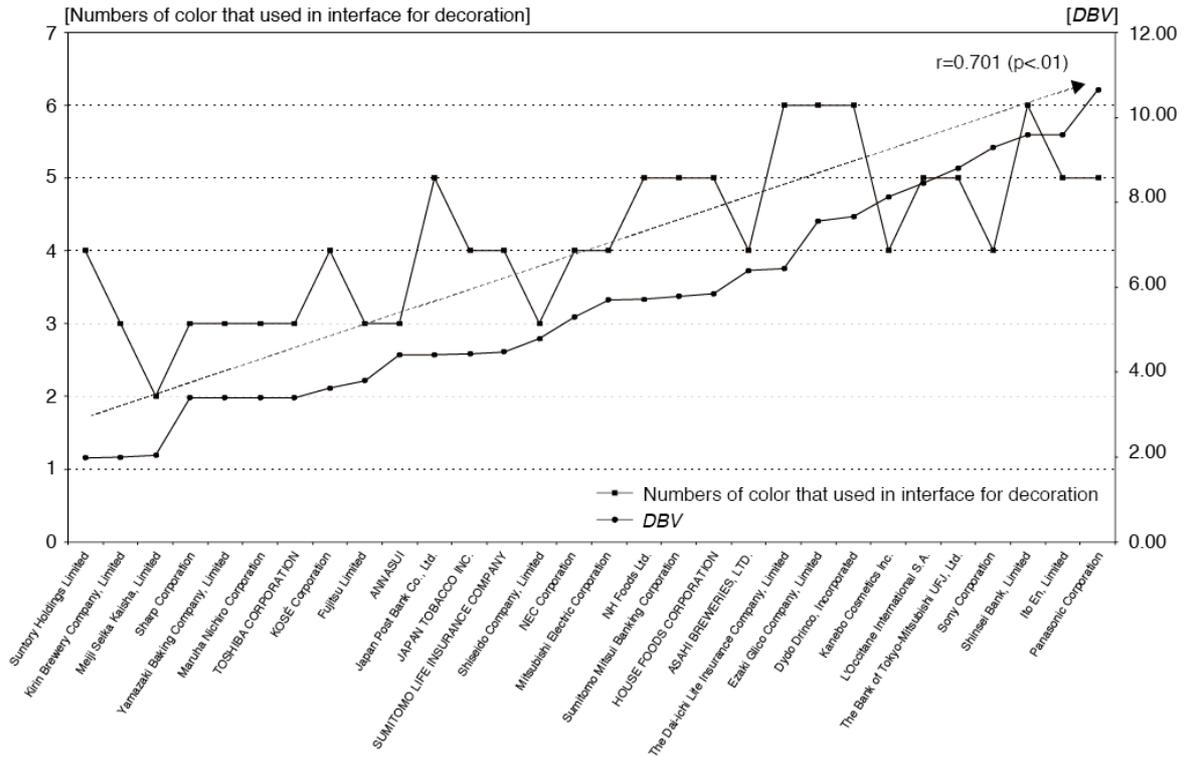
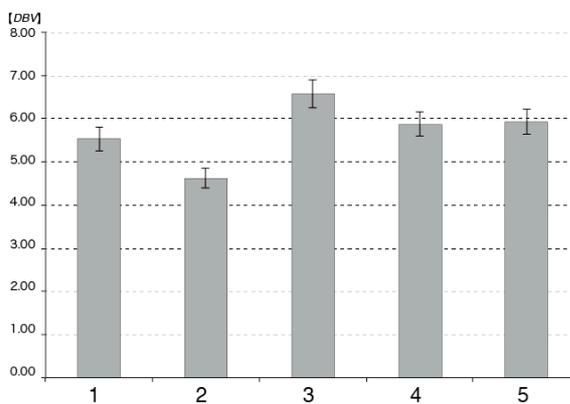


Figure 4 : The relationship between *DBV* and number of colors



- 1: brewing company & Beverage manufacturer
- 2: food maker & confection company
- 3: finance and insurance industry
- 4: cosmetics maker
- 5: electronics company

Figure 3 : Averages of *DBV* of sample sites

- Food maker and confection company : 7 sites
- Finance and insurance industry : 6 sites
- Cosmetics maker : 5 sites
- Cosmetics maker : 7 sites

In this research, we have extracted the color of the following elements decorative implication is strong.

1. Logo type and/or symbol mark
2. Background color of the site
3. Background color of the contents
4. Background color of the header
5. Background color of the footer

To take a screen shot of the top page of the web site of the company as shown in Figure 2-A, to examine the color of the element corresponding to (1)-(5). It is shown in Figure 3 the averages of the *DBV* of decorative color of the web site of each industry. There was no significant difference between the *DBV* of different web site of industries.

It is shown in Figure 4 the relationship between the number of colors in interface design and *DBV*. Significant there is a correlation between the number of colors used in a screen and the *DBV* ( $r=0.701$ ,  $p<.01$ ). Color design number of colors used on the screen often has been found that the *DBV* is high. Therefore, low color design of *DBV* applications to the web site of the simple structure it was concluded to be suitable.

#### 4 EXPERIMENT

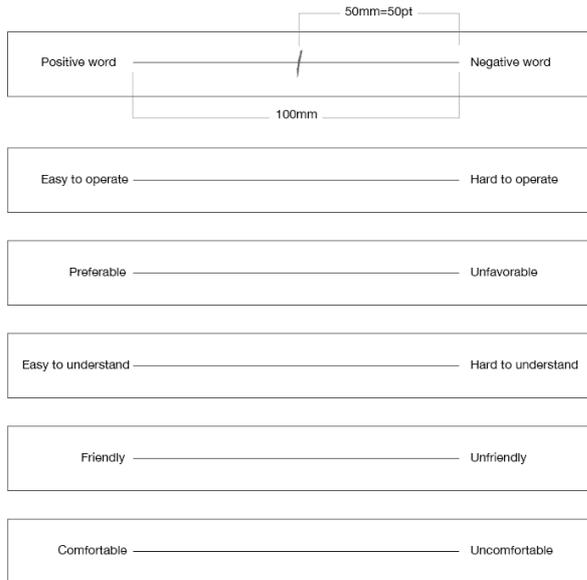
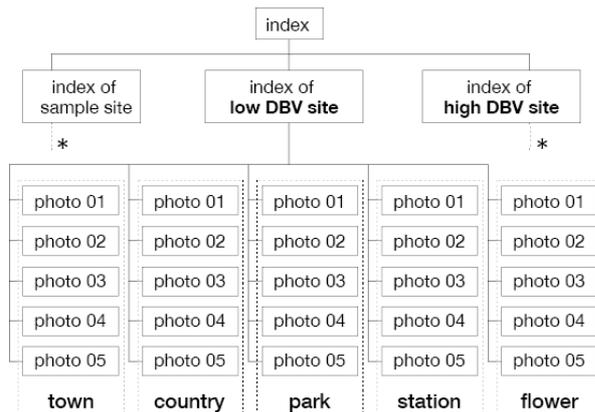


Figure 5 : Items of evaluation of impressions of experimental sites



\* The sample site, the low DBV site and the high DBV site have the same structure.

Figure 6 : Site map of the experimental site

We look at the effect of low *DBV* color design on operation.

In the experiment, you get the same operation on the web site of low *DBV* design web site and high *DBV* design to the subjects. The subjects are healthy 16 women from 18 to 22-year-old. They have an experience that necessary specialized knowledge for design. In addition, they are accustomed to computer operations. The subjects get looking to operate the web site a photo that was chosen at random. And from the start of operation of the web site, and the time to photograph the target is found, we were asked to subjectively evaluate the impressions of operation.

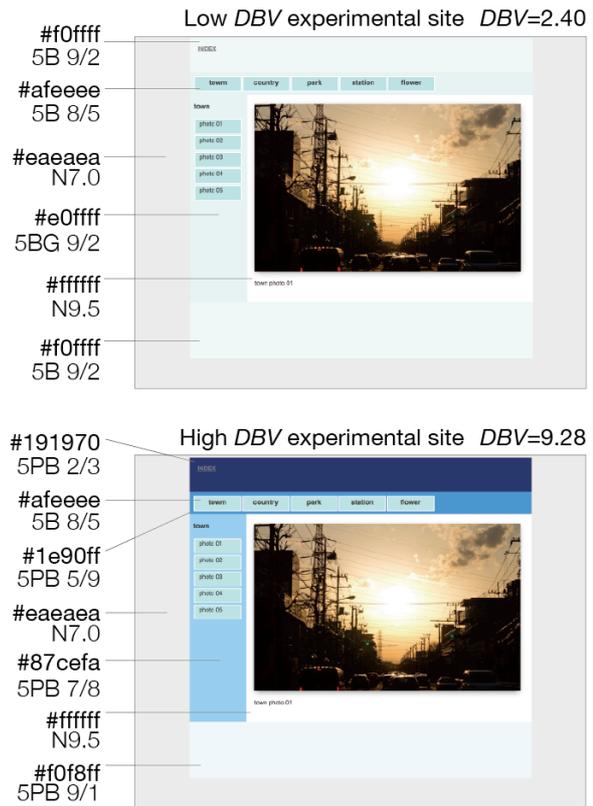


Figure 7 : Screen shots of Experimental sites and those *DBV*

The flow of the experiment is as follows.

1. A subject is received a description of the experiment.
2. Use the sample site to explain the operation.
3. Operate **the low *DBV* site** (Half of the numbers of the subjects to operate **the high *DBV* site.**).
4. Measure the time of passed during the task.
5. Subject to evaluation impression respect to the operation sites.
6. Operate **the high *DBV* site** (Half of the numbers of the subjects to operate **the low *DBV* site.**).
7. Measure the time of passed during the task.
8. Subject to evaluation impression respect to the operation sites.

After the operation, we were asked to evaluate these five items on the subject using Visual Analogue Scale. Figure 5 shows evaluation sheet used in the experiment. The following five items we were asked to impression evaluation to the subjects.

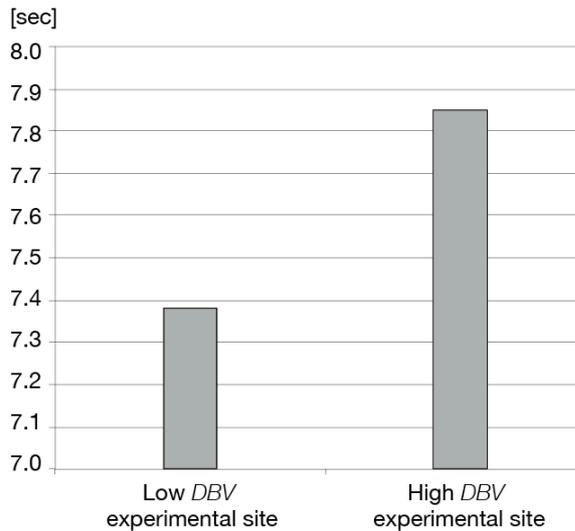


Figure 8 : Averages of time passes during a task

1. Easiness to operate
2. Preferable
3. Easiness to understand
4. Friendliness
5. Comfortableness

The structure of the experimental site is shown in Figure 6. Experimental site is a simple tree structure. And there are 25 photos in the experimental sites. 25 photos have been classified into five categories of “town”, “country”, “park”, “station” and “flower”. The subjects quickly find photos that were selected at random from the sites.

Color codes (RGB & Munsell color system) of the experimental sites are shown in Figure 7. *DBV* of low *DBV* site is 2.40. *DBV* of high *DBV* site is 9.28. Bluish color, regardless of the subject's age and culture, it is less likely to be hated [5]. In other words, it is considered that fewer preferences simmer influence of each subject. Therefore the colors of the experimental sites it was decided to use bluish colors. But, the color of the push buttons both sites are the same.

Figure 8 shows averages of time passed during a task in the experiment. In the experimental site of low *DBV*, it took 7.4 seconds to operation on average. On the other hand, in the site of high *DBV*, it took 7.9 seconds to operation on average. Thus, when using a low contrast color scheme, time required for the operation was 0.5 seconds shorter. However, there is

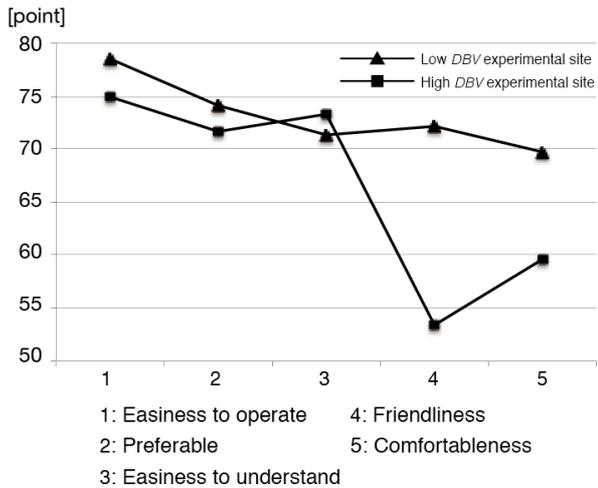


Figure 9 : Averages of evaluation of impressions on 2 experimental sites

no significant difference between the speed of operation of high *DBV* experimental site and low *DBV* experimental site.

Figure 9 shows the averages of evaluation of impression of operation on 2 experimental sites. The impressions of easiness to operate, referable, easiness to understand were almost the same. However, the impression of friendliness and comfortable were higher when using the low *DBV* site. In particular, there is a significant difference ( $.05 > p > .01$ ) between evaluation of easiness to understand using high *DBV* colors and evaluation value of easiness to understand when using low *DBV* colors.

Therefore, as compared to the case it is not a case of using colors of low *DBV*, the users can be presumed easy to operate and to relax. Although there was no significant difference, more in the case of operation at low *DBV* screen is, operation time was shorter. Thus when using the color of the lower *DBV* to the web interface, it is thought that a good influence on the operation.

## 5 Conclusion

In this paper we have discussed the color design of easy operation interface for the users. The authors have proposed a value of *DBV* as an indicator of the user easy to operate color design. At first, we examined the application of the *DBV* to the web interface. Of each of the elements of the web

interfaces, it was considering the position on the two axes. And, logo mark (or symbol mark), background color of the site, background color of the contents, background color of the header, background color of the footer was concluded to have a highly decorative color.

Next, we investigated the color corresponding to these parts of the corporate web site. As a result, colors used in these parts is large sites it was found that *DBV* is high. Therefore, the web site of simple structure is to apply the color low *DBV* we have concluded that it is appropriate.

Furthermore, we look at the effect of interface that is low *DBV* on operation. In the experiment, you get the same operation on the web site of low *DBV* experimental site and high *DBV* experimental site to the subjects. And from the start of operation of the web site, and the time to photograph the target is found, we were asked to subjectively evaluate the impressions of operation.

The result of the experiment, there is a significant difference ( $.05 > p > .01$ ) between evaluation value of easiness to understand using high *DBV* colors and evaluation value of easiness to understand when using low *DBV* colors. In addition, when using a low *DBV* experimental site, time required for the operation was 0.5 seconds shorter. Therefore, as compared to the case it is not a case of using colors of low *DBV*, the users can be presumed easy to operate and to relax. Although there was no significant difference, more in the case of operation at low *DBV* screen is, operation time was shorter.

Thus when using the color of the lower *DBV* to the web interface, it is thought that a good influence on the operation. Based on the experimental results in the future, we want to make the creation system of color design of the web interface.

## REFERENCE

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[5] Yamamoto Toshio : Basic of color science, Bunka syobo hakubun-sya Co., Ltd. , 1997. (Japanese)

## APPENDIX

The companies with the URL of the web site that has been adopted as the sample referred in chapter 3. These designs have been investigated in December 2015.

Suntory Holdings Limited  
<http://www.suntory.co.jp>  
 Kirin Brewery Company, Limited  
<http://www.kirin.co.jp>  
 Ito En, Limited  
<http://www.itoen.co.jp>  
 Dydo Drinco, Incorporated  
<http://www.dydo.co.jp/index.html>  
 ASAHI BREWERIES, LTD.  
<http://www.asahibeer.co.jp>  
 Ezaki Glico Company, Limited  
<http://www.glico.co.jp>  
 Meiji Seika Kaisha, Limited  
<http://www.meiji.co.jp>  
 JAPAN TOBACCO INC.  
<http://www.jti.co.jp>  
 Yamazaki Baking Company, Limited  
<https://www.yamazakipan.co.jp>  
 HOUSE FOODS CORPORATION  
<http://housefoods.jp/index.html>  
 Maruha Nichiro Corporation  
<http://www.maruha-nichiro.co.jp/index2.html>  
 NH Foods Ltd.  
<http://www.nipponham.co.jp>

Japan Post Bank Co., Ltd.  
<http://www.jp-bank.japanpost.jp>  
Shinsei Bank, Limited  
<http://www.shinseibank.com>  
The Dai-ichi Life Insurance Company, Limited  
<http://www.dai-ichi-life.co.jp>  
Sumitomo Mitsui Banking Corporation  
<http://www.smbc.co.jp>  
SUMITOMO LIFE INSURANCE COMPANY  
<http://www.sumitomolife.co.jp>  
The Bank of Tokyo-Mitsubishi UFJ, Ltd.  
<http://www.bk.mufg.jp>  
ANNASUI  
<http://www.annasui-cosmetics.com/top.html>  
Shiseido Company, Limited  
<http://www.shiseido.co.jp>  
L'Occitane International S.A.  
<http://www.loccitane.co.jp>  
KOSÉ Corporation  
<http://www.kose.co.jp/jp/ja/index.html>  
Kanebo Cosmetics Inc.  
<http://www.kanebo-cosmetics.co.jp>  
Sony Corporation  
<http://www.sony.jp>  
Panasonic Corporation  
<http://panasonic.co.jp/index3.html>  
TOSHIBA CORPORATION  
[http://www.toshiba.co.jp/index\\_j3.htm](http://www.toshiba.co.jp/index_j3.htm)  
NEC Corporation  
<http://jpn.nec.com>  
Fujitsu Limited  
<http://www.fujitsu.com/jp/>  
Sharp Corporation  
<http://www.sharp.co.jp>  
Mitsubishi Electric Corporation  
<http://www.mitsubishielectric.co.jp>