CULTURE COLOUR PREFERENCES FOR CROSS-CULTURAL WEBSITE DESIGN

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Abstract: *Users from various cultures not only speak different languages, but also think and act differently. These differences impact process of how users perceive and use information systems, including websites. Therefore there is emerging need for models, methods and technologies for design of usable cross-cultural websites. One of the main tasks relating to usable cross-cultural website design is to gather data about cultural preferences for a selected culture. In this article methods for culture colour preference identification are summarized. Improved method is introduced for gathering not only colour names, but also colour saturation data from websites. The comparison of results of two method executions is performed within a process for gathering Japanese website design colour preferences. From results of scanning web browser rendered website images, it can be seen that extracting colour saturation data give more precise and different results than executing the colour code extraction method.*

Keywords: cross-cultural design, website, colour extraction, usability.

Introduction

Websites is a widespread communication tool. Initially Internet services, including websites, were developed typically for users from western countries mainly in English language. But only 8-10% of the world population and 35% of website users use English as their primary communication language (Takasaki & Mori, 2007). It is concluded by various authors that such cultural differences as language, perception of information, thinking patterns and communication style can significantly impact website usability (Rau et al., 2011). Because of such conclusions there is increased demand for research about cross-culturally usable website design models, methods and technologies.

There are two design strategies known in a cross-cultural design. One is internationalization and the another is localization (Smith et al., 2004). Internationalization is a process that includes tasks for design of product or service that is not sensitive against culture differences (Marcus & Baumgartner, 2004). Usually product internationalization is achieved with avoidance of design elements that are culture sensitive, such as religious references and symbols (Young, 2008). Localization is a process that includes product or service adaptation for certain language and culture (Young 2008; Marcus & Baumgartner, 2004). For example, to perform localization of website, besides translation of language, such tasks as use of time zones, format of currency, use of colour, product and service name decision and others must be considered (Vyncke & Brengman, 2010). In various studies researchers conclude that localization strategy must be used to achieve improved product usability results (Simon, 2001; Marcus & Rau, 2009; Cyr et al., 2005).

To use localization strategy for cross-cultural website design, there is a need to identify variables or dimensions which can be diverse in various culture websites. One such dimension is colours that are used in culture websites.

The aim of this article is to summarize and improve identification process of culture colour preference for design of cross-cultural websites. To reach the aim, following tasks are brought forward:

- Summarize methods to identify culture colour preference for cross-cultural website design.
- Suggest method to identify culture colour preferences by scanning existing websites and collecting data about used colours and colour saturation.

Materials and methods

Various studies suggest evaluation of certain cultural dimension groups. For example, Barber and Badre (Barber & Badre, 1998) suggest such dimensions as colour, spatial organization, fonts, shapes, icons, metaphors, geography, language, flags, sounds, motions, writing direction and navigation.

Smith (Smith & Yetim, 2004) mentions colour, colour combinations, banners, trust signs, metaphors, language and navigation. Cyr and Trevor-Smith performed analysis of design elements in 30 websites from Germany, Japan and USA. They concluded that symbols, colours, links, navigation maps, search functions, layout of information and language are the dimensions that differ across cultures (Cyr & Trevor-Smith, 2004). Aykin and Milewski (Aykin & Milewski, 2005) highlight such dimension groups as graphics, language and translation, formatting of objects, colour and layout. Rau with co-authors (Rau et al., 2011) also suggest similar dimension groups which are language, format, presentation, layout, graphics and colour.

It can be seen that practically every division mention colour as one of the culture variable or dimension, that is important for design of usable cross-cultural information systems.

Humans learn colour associations and those associations are bound with culture. Meaning of certain colour in various cultures can be different (Barber & Badre, 1998; Clarke, 2005). For example, Chakraborty and Norcio (Chakraborty & Norcio, 2009) study shows confirmation of previously published Barber and Badre red colour association observations with people from China and USA. Other studies also confirm such associations (Choong, 2006). Callahan admits that inattentive selection of colours for website design can impact cross-cultural usability (Callahan, 2006a).

Ashok and Jacko (Ashok & Jacko, 2009) mention an example about the widespread use of red colour in Indian wedding ceremony, while Christian ceremonies usually use white colour. Therefore, when designing Indian wedding agency website the use of white colour as predominant is not acceptable.

Barber and Badre also conclude that the use of colours for cross-cultural website design can impact user expectations towards navigation, content, links and overall impression of system (Barber & Badre, 1998).

For example, Cyr with co-authors analyse *SAMSUNG* localized websites with users from various cultures. This study shows that, for example, Japanese users regardless of the fact that they have the Japanese version of *SAMSUNG* website prefer Hong Kong website. Japanese users found colour, image saturation, animation and layout of Hong Kong version more suitable and attractive than Japanese one (Cyr et al., 2005).

Simon (Simon, 2001) concludes that Asian culture people prefer darker colours, but European and North American users prefer brighter colours. Colours are often linked to religion that predominates in culture. For example, saffron yellow colour is sacred colour in Indian, Sikh, Jain and Buddhist religions (Rau et al., 2011).

Colour application in website design also can be linked to politics. For example, Malaysian government websites never include green colour as predominant. It is related to the fact that government opposition official colour is green (Hussein et al., 2009). Barber and Badre in their study (Barber & Badre, 1998) conclude that when designing websites for government institutions, all studied countries, except Brazil, gave preference to colour scheme which is predominant in cultures country flag. For example, French government websites designs mostly use blue, white and red colour, while Libyan government websites use green as a predominant colour.

Colour meaning is also linked to context of application. For analysis of colour meaning Bourges-Waldegg and Scrivener (Bourges-Waldegg & Scrivener, 1998) propose a model that includes 3 concepts such as colour, meaning and context. For example, purple (colour) represents God (meaning) in Japanese religion (context). The other authors also recommend to use this model for colour meaning collection and analysis for selected culture (Callahan, 2006b).

When generalized, Chattopadhyay with co-authors conclude that blue colour is most universal for website design (Chattopadhyay et al., 2002). Kondratova and Goldfarb (Kondratova et al., 2007) in their study analyse websites from 26 countries and conclude that most universal colours are white, black, various tones of grey, various tones of blue and light yellow. These authors also present prototype tool that allow to automate website content analysis (Kondratova et al., 2007). According to those authors this tool also can be used for culture colour preference analysis. Designers using this tool can scan target culture domain websites, examine and extract colour names from website *Cascade Style Sheet* (*CSS*) code. However, Kondratova and Goldfarb admit that this tool cannot read colours from images. In case website colours are not defined using *CSS*, that tool cannot determine colours that are used in website. This tool also cannot determine colour saturation, which means that colour of a single word letter can have same weight as a whole page background (Kondratova et al., 2007). There is a need for methods that allow determining as well as colour saturation from rendered websites in user's web browsers.

The content analysis of target culture websites is one of the most used methods for identification of culture colour preferences for a cross-cultural website design (Kondratova et al., 2007). Usually for such analysis certain set of websites from a target culture is selected. Often, this set is built from the most popular websites using website visiting statistics. For example, Kondratova and Goldfarb (Kondratova et al., 2007) use *Google* statistics, while the other authors (Vitols et al., 2011) use also *Amazon Alexa* website statistics.

For identification of colour preferences other methods also can be used. One of suggested methods is from Chavan's *Quick and Dirty User Profiling Technique* (*QDUPT*) (Chavan, 1999). *QDUPT* basically includes three methods that can be viewed as heuristic and allows product designers to acquire basic preferences from the target culture. One of the methods, for target culture user preferences suggests performing analysis of the most popular local music videos and movies within last 5 years.

Based on Chavan's suggestion and Braun and Rose study (Braun & Rose, 2007) with application of these methods for Korean preference identification, we suggest to use these methods for colour preference identification. When combining such methods overall method for colour preference identification can be developed (Fig. 1).

As a target culture for this study we selected Japan. To acquire Japanese website colours, the third and the fourth method from Fig. 1 were used. Analysis of 100 most used local websites in Japan has been performed.

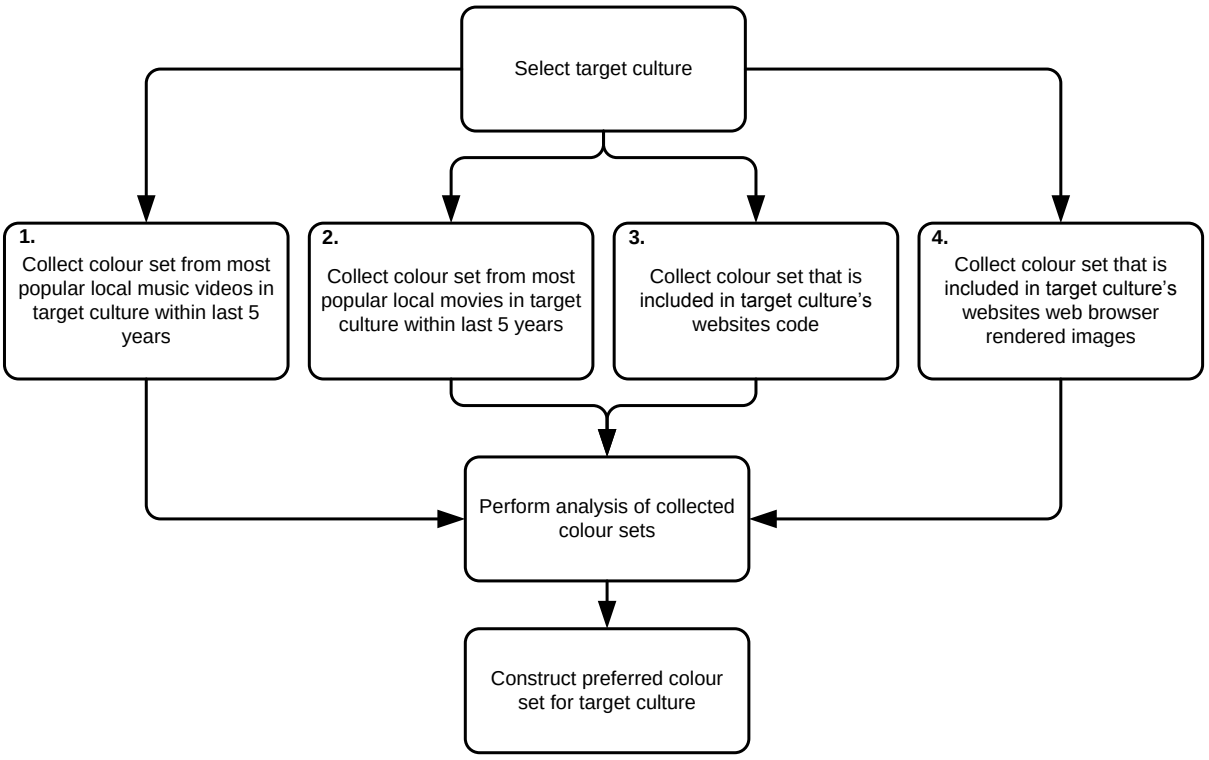

Fig. 1. **Methods to identify culture colour preference**.

To gather such data there is a need to scan web browser rendered website content and examine website codes. As more than 90% of Japanese websites use *CSS* for coding colours (Vitols et al., 2011), *CSS* code scanning must be performed. *CSS* can be added to website by embedding *CSS* into the base code, usually *HTML* code, by adding inline *CSS* to *HTML* tags or by linking to a separate *CSS* file. Linking to a separate *CSS* file is the most common method for Japanese website design, which were discovered during our previous study (Vitols et al., 2011).
To execute the third method mentioned in Fig. 1 there is a need to perform the following operations:

1. Scan selected website source code for extraction of *CSS*.
2. Extract *CSS* files, including those that are formatted by importing *CSS* file from within another *CSS* file.
3. Extract *CSS* file and run the code with *CSS* parser software for colour code extraction in hexadecimal notation for the combination of Red, Green, and Blue colour values.
4. Clean colour codes from values that are not written as 3 double digit numbers, starting with a # sign.
5. Get rid of colour code duplicates which appear in multiple *CSS* files within a single website.
6. Convert shorthand hexadecimal notation that abbreviates 3-character *CSS* colours into 6-character notation.
7. Load extracted data into database and perform data analysis.

To execute the fourth method mentioned in Fig. 1 there is need to perform the following operations:

1. Select a tool that can scan websites and prepare screenshot of an index page for each website.
2. Set up screenshot preparation properties and write a batch file for screen shot preparation tool.
3. Execute colour analysis of prepared screen shots with an image analysis script.
4. Collect colour and colour saturation data.
5. Load collected data into database and perform data analysis.

Results and discussion

To collect data about 100 most popular Japanese websites, *Amazon Alexa Top Sites* website statistics was used. The sites in the *Alexa Top Sites* lists are ordered by their 1 month *Alexa* traffic rank. The 1 month rank is calculated using a combination of average daily visitors and page views over the past months. The site with the highest combination of visitors and page views is ranked number 1. Target culture websites which were chosen are listed in *Alexa Top Sites* Japanese list and are written in Japanese language. Data about popular websites was collected during November 2011.
For extraction of colour codes from *CSS* files, we used *CSS* parser for colour code extraction written in *JavaScript* and published by *ThriveSmart* (ThriveSmart, 2007). This *CSS* parser script allows extracting colour codes from *CSS* files in hexadecimal notation for combination of red, green, and blue colour values. Extracted values were imported in *Microsoft Excel* for corrupt and duplicate colour code identification. With *Microsoft Excel* conversion of shorthand hexadecimal notation colour codes to 6-character notation was also performed. Afterwards data was loaded with *Oracle SQL Loader* into *Oracle Express Edition* database and data analysis with *SQL* language queries was performed.

For extraction of colours from rendered website we used the following tools and steps. To prepare screenshot of an index page for each website *WebShot 1.8.8* (Moinvaziri, 2011) tool was used. *WebShot* allows automating whole website index page screenshot preparation. For automation of process *WebShot* batch file was created and executed. Screenshot size was dynamically adjusted to website index page size and screenshots were saved in *JPG* image file format. Screenshot was prepared using *Internet Explorer 8* web browser with *Trident* layout engine.

For analysis of screenshots, the web based image analysis tool was developed using *PHP* language. As a base for the image analysis tool, *Color Extract PHP* class developed by Csongor Zalatnai and Kepler Gelotte was used (Zalatnai & Gelotte, 2011). Image analysis tool allows extracting most common colours in image and identifying saturation of each colour in a given image. 50 most common colours from each website screenshot were extracted. Afterwards data was loaded with *Oracle SQL Loader* into *Oracle Express Edition* database and data analysis with *SQL* language queries was performed.

After the data analysis, colours were arranged by most used ones. To rank results of *CSS* code extraction method we count instances of certain colour. For example, black colour with hexadecimal notation #000000 was identified 165 times, while grey colour with hexadecimal notation #CCCCCC was identified 117 times.

To rank results of website rendered image analysis method we identified overall percentage of colour saturation in screenshots of analysed websites. Overall more than 3000 unique colours were identified using *CSS* code extraction method and 2460 unique colours using website rendered image analysis method. 100 most used colours were ranked. Ranked results can be partially seen in Table 1 and Table 2.

Table 1

Most used colours in Japanese website design collected using *CSS* code analysis method

Rank	Rendered colour	Hexadecimal notation
1.		000000
2.		ffffff
3.		cccccc
4.		333333
5.		999999
6.		666666
7.		dddddd
8.		ff0000
9.		eeeeee
10.		aaaaaa

Table 2

Most used colours in Japanese website design collected using rendered image analysis method

Rank	Rendered colour	Hexadecimal notation
1.		507088
2.		ffffff
3.		808080
4.		f8f8f8
5.		587890
6.		f0f0f0
7.		101010
8.		e8e8e8
9.		f0f0e8
10.		98c040

To display proportions of colour use in Japanese website design, we grouped collected colours using the colour wheel of basic colour groups (Mollon, 2003). Basic colours of the colour wheel are blue, red and yellow. The secondary colours are green, orange and purple (Mollon, 2003). We used these 6 colours to generalize results and give approximate saturation for each of these colour groups in Japanese website design. As additional to 6 main colours we also included grey, but exclude white and black. The results of this division are displayed in Figure 2 and Figure 3.

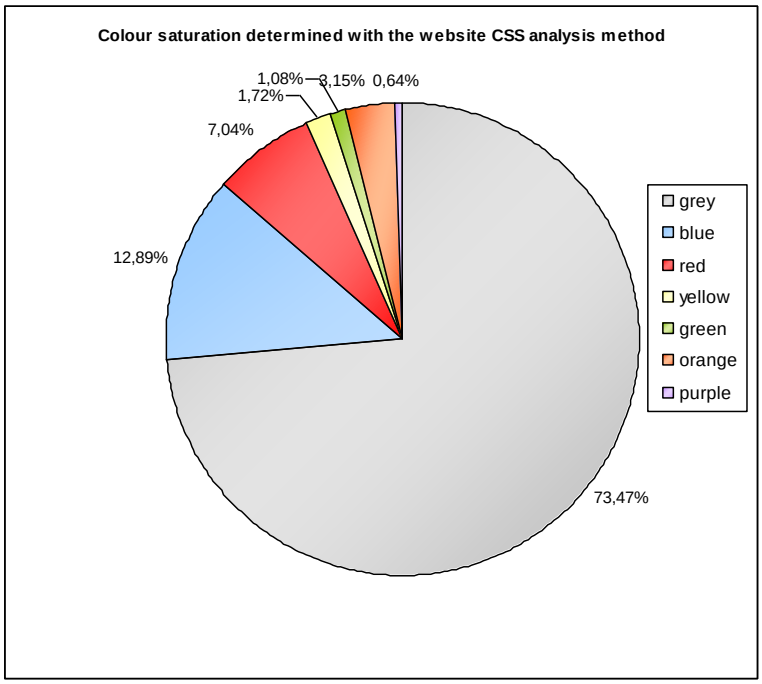

Fig. 2. **Basic colour group saturation in Japanese website design. Determined with the website *CSS* analysis method.**

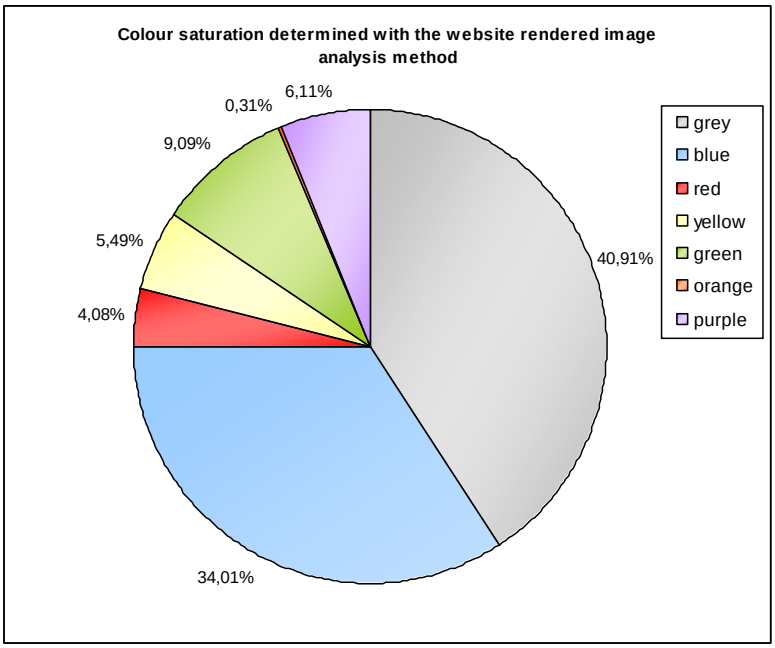

Fig. 3. **Basic colour group saturation in Japanese website design. Determined with the website rendered image analysis method.**

As it can be seen in Figure 2 and Figure 3 that large portion of website colour saturation takes grey and blue colour variations.
It is seen that Japanese website designers mostly use blue, gray and green colour combinations as main for their website design. This confirms previously gathered results from manual evaluation of Japanese websites (Vitols et al., 2011).

Conclusions

As we compared the results from each method, we found there is a significant difference. The method when snapshot of rendered website is taken and examined gives more precise results with taking into account data about colour saturation and colours from images that published in the website.
Suggested software solutions successfully assist execution of both reviewed methods and can be used in further studies.

Website content analysis with scanning *CSS* files is one of the most used methods for identification of culture colour preferences for cross-cultural website design. However this method provides only rough colour preference data.

For execution of rendered image analysis method only index page snapshot for each website was examined. Snapshot evaluation of multiple pages from a single website could give slightly different and more precise results. However main page usually include design frame, banner and central image which can give close to reliable colour saturation data of the website.

It is seen that Japanese website designers mostly use blue, grey and green colour combinations as main for their website design. These results partly confirm results that were gathered by Chattopadhyay (Chattopadhyay et al., 2002) and Kondratova (Kondratova et al., 2007).

Proposed method which allows determining colour saturation further can be used for development of cross-cultural website design consulting software.

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