Colour and Image Issues in Web Development

Tanya Linden
Department of Information Systems
University of Melbourne
Vic 3010, Australia
tanyal@.unimelb.edu.au
http://www.dis.unimelb.edu.au/staff/tanya
ph: +61 3 8344 1525
fax: +61 3 9349 4596

and

Jacob L. Cybulski
School of Information Systems
Deakin University
Burwood, Vic 3125, Australia
jlcybuls@deakin.edu.au
http://www.deakin.edu.au/~jlcybuls/
ph: +61 3 9244 6847

Abstract

This paper describes a small set of patterns that are produced in a process of domain-wide pattern mining. We provide a brief description of the experience mining process across web development domain and explain how the resulting pattern languages were discovered. A subset of the mined patterns was selected for this paper because of their pertinence to most web development projects, i.e. colour scheme and readability issues and images download issue.

1. Introduction

Crafting the first draft of a pattern or sometimes a pattern language is commonly based on "mining" one's own experience (Manns and Rising 2002). This process is normally undertaken by a small group of pattern mining enthusiasts, who may or may not have rich domain experience to warrant accuracy of the resulting patterns. Practitioners, however, whose experience is invaluable to deriving high quality patterns, often do not participate in this process. To deal with this problem of involving practitioners in pattern writing activities, several approaches employing *'ghost writer'* services were proposed (Rising 1999). A ghost writer is an expert pattern writer whose task is recording practitioners' experience in the format of a pattern, so that the experience in the core of the formalised pattern could be sourced directly from practitioners. In such a process, the 'ghost writer', also referred to as a 'mercenary analyst' (Coplien 1996), would normally collect practical experience by means of interviews and meetings (Rising 1999).

At the same time quite often patterns reflect problem-solving knowledge of a single person, a small team of people working together or at best collected within an organisation (Rising 1999). Literature on knowledge acquisition shows benefits of expertise gathering across a problem domain (Gaines and Shaw 1993). There exist numerous knowledge elicitation methods that support this process, e.g. by means of interviewing experts across a domain and collecting data containing practitioners concerns and problems they have to solve that can be represented in the format of patterns. This approach will have a benefit of collecting domain-wide experience by directly engaging practitioners who are rarely involved in the pattern crafting / mining process. We have applied this approach to mining a pattern language for web-front development and a selection of crafted patterns are presented in this paper.

2. Towards a Pattern Language on Colour Issues in Web Development

Since we interviewed practitioners working on front-end web development, the presented patterns are expected to be of most use to designers of web sites, especially people with beginner to intermediate level of skills.

During interviews practitioners reflected on the recurring problems that have to be considered in the projects concerned with development of web sites. These problems were encountered while performing various design tasks. Some of the most common design tasks included:

- *Selecting a colour scheme*
- Laying out information / use of templates
- Designing navigation
- Designing menus
- Selecting fonts
- Usability issues (screen size, various browsers and their versions of site users)
- Addressing accessibility issues
- Software applicability for design tasks

Several pattern languages could be discovered by examining each design task and its various aspects. The identified concerns could subsequently be fused into a small pattern language. We would like to point out that this list of concerns does not cover all problem issues in the colour scheme task but only those that were clearly identifiable from the interviews we conducted. The presented draft of a pattern language therefore represents the concerns of the selected group of domain practitioners and not ours - the ghost writers. For the collected patterns to be considered a fully formed pattern language, we need to capture experience of a much broader community of domain practitioners, which is our future work.

Our study explored aspects of selecting a colour scheme in web site development. Design issues of greatest interest to the study participants included those related to business, technical and perceptual nature of colour schemes. The aspects of the colour selection tasks ranged widely from compliance with industry and business standards, through human perception of colour combinations, to the effects of clients technology on the presentation of colour images and text. For this paper, we selected four design aspects as relevant to every project described by the participants of the study (see the highlighted aspects of Table 1). These aspects have subsequently been developed into full patterns. Other aspects of the pattern language have not as yet been cast into the pattern format.

The task of selecting a colour scheme seemed to cause difficulties for web designers because of the constraints imposed on the designer by the client and by technology limitations (as will be shown in the patterns). The first pattern looks at the impact of corporate colours on web design. The second pattern focuses on the constraints imposed by web technology on the use of colour schemes. The third pattern discusses influence of a colour scheme on the readability of web pages. The fourth pattern, among other issues, is concerned with the impact of the number of colours in the image palette on the file size and therefore image loading time. The last concern is well-known and was reflected in some of the early web-related patterns (Orenstein 1996).

Some context and forces are common to all patterns from “Selecting the Colour Scheme” pattern language. We also repeat these common context and forces in patterns where they are

Table 1 – Possible pattern language outline for a “Selecting a colour scheme” task

Design issues	**Aspects of design tasks to be considered**
Business issues	• ***Reproduction of Corporate Colours on a Web Site*** • Colours coming from industry
Perceptual issues	• Traditional acceptance of blue and white • Offsetting one colour with another • Offsetting bright colours with neutral areas • Subjective perception of colours and colour schemes • Introducing “surprise” colours • ***Text and background colours***
Technical issues	• ***Web safe palette*** • Editing software colour tables • ***Dealing with file size***

especially important.

Common Context:

Some users still use old monitors.

Most users do not have their monitors calibrated.

Monitors use additive colours RGB (red, green blue), colours formed by light. RGB model is called additive because adding red and green gives yellow, blue and green give cyan, blue and green give magenta. All three colours together produce white.

Printers use CMYK colour model. The primary colours (cyan, magenta, yellow to which blank ink named K is added) are subtractive. When added together they produce black.

There is the third colour model where colours are described by three properties:

- Hue – the actual colour itself
- Saturation – the amount of colour that is present
- Value – shade or brightness of the colour (measured on the grey scale)

Common Forces:

All colour models provide a way of specifying numeric representation for a colour, therefore removing subjective factors of colour perception. However, numbers are often meaningless for humans and graphics programs support "human factor" by providing colour picker dialogs based on one of the colour models.

Any user viewing a web page designed for RBG colour reproduction should be able to get its quality print copy which uses a CMYK colour scheme. However, the range of RGB and CMYK colours do not fully overlap.

It is desirable that all potential web page viewers see the same colours in the highest quality, irrespective of their client-side technology.

A web page should look the same to all users regardless of platform and browser they are using, however, this is rarely the case.

2.1 Name: Reproduction of Corporate Colours on a Web Site

Problem:

How to select a colour scheme for the web site close to existing corporate colours?

Context:

Colours to be used in web design are usually provided by the client.

The client usually wants their logo to be on the web site.

Forces:

Colours specified by the client sometimes look great in print but not on screen.

Most businesses do not know the unique identities of colours used on their business stationary, however, colour identities could be obtained by scanning existing business stationary.

Although colours could be scanned from stationary, unless the monitor has been properly calibrated the colours may still look different from their print version.

While colour hue and shade are very important in determining individual colours to be used on a web page, it is contrast between colours which makes a web page readable.

Some colour schemes are suitable for screen presentation, others are very hard to read on screen.

Colours, their weight and overall balance have significant impact on the web site perception. Colour scheme of a web page is an important element of the design because the attention of the eye can be directed through the use of colour, however, it can be subjective and thus the effect may be hard to predict. Colours have subjective attributes based on their psychological associations, such as cool and warm colours. For example blue and green are associated with cold whereas red and yellow with warmth. Also blue is often associated with sky and water, green with growth, red with fire, etc (Wands 2002). There are also fashionable colours, for example Microsoft introduced blue based palette in Windows 98 and later versions and many developers followed this fashion.

Solution:

If colour identities are not known, scan the business card/stationary then

Select closely matching colours which look good on screen;

Maintain the overall weight and balance of colours on each web page;

If necessary, introduce additional colours to repair the contrast.

Use the RGB colour model to manipulate colour schemes designed for the screen viewing.

Resulting Context:

The colour scheme of the web site is still in line with the corporate colour scheme.

The colour scheme of the web site is suitable for screen viewing.

Pros:

Introducing additional colours is less intrusive than changing colours.

Cons:

Loss of integrity of corporate colours may occur when changing the entire colour scheme.

Comments:

Issues of colour reproduction and use are well known to photographers, printers and graphic designers. However, as can be seen from the above pattern, web developers are focusing only on a limited range of colour-related issues.

While this pattern may seem simplistic to laymen, graphic designers are quite adamant that the outlined problem and its recommended solution encapsulates years of their experience. This is what one of the quite experienced web developers said in the interview on this matter:

> "Often one of the hardest bits when you get a web design job is nine times out of ten your client doesn't actually know what they want beyond of the level of, "I want a website". A lot of it is often left up to the designer, so you have that initial mental block that says, "How do I start? What can I actually give them?" So if you had a collection of these [patterns - TL], you'd then sort through. You'd find, there might be more then one where the context and the forces are close enough to your current situation, so then you'd have you basic starting places."

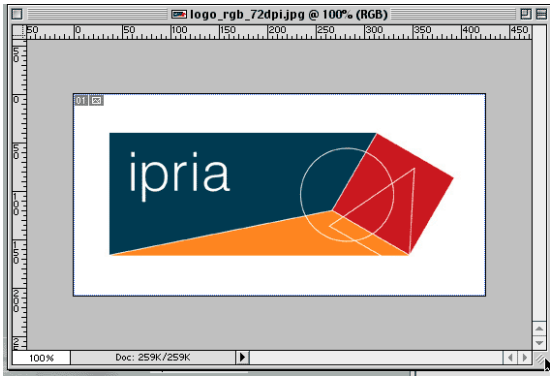
Examples/Known Uses:

The interviewed graphic designer applied this pattern for the development of the IPRIA web site. The old site did not use colours from business stationary so the designer took a different approach. She asked for exact colours of the logo and was very happy to receive them in electronic format which meant she did not have to search for closest matching colours. She actually used the logo to design the menu of the website and also maintained the colour scheme of the logo through the website (see Figure 1).

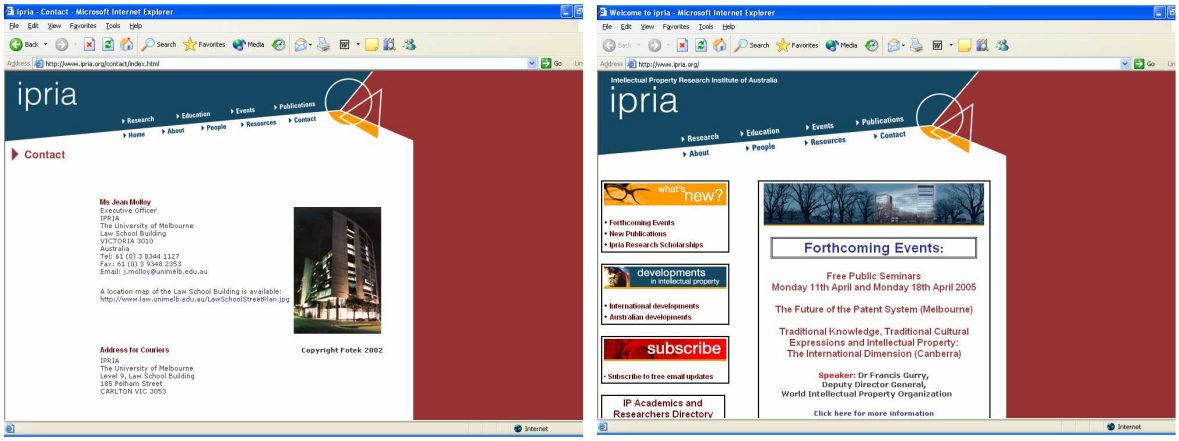
Related patterns:

The "Reproduction of Corporate Colours" pattern would normally be applied first to decide on general colour scheme of the web site. However, depending on the potential users of the corporate

(a) Old Web Site



(b) Business logo



(c) Current website

Figure 1 - Use of Business Colours in Website Design

web site there may be a need to restrict the colour scheme by the web safe palette – see the "Web Safe Palette" pattern.

Additional advice on the selection of the colour palette for a website can be found in the "Colour Palette" pattern (Mellor).

2.2 Name: Web Safe Palette

Problem:

How to maintain web colour consistency across various platforms and browsers?

Context:

Some users still use old monitors.

Most users do not have their monitors calibrated.

A web safe colour palette is set of 216 colours believed to be supported by all web browsers in the same way. The colours in the web safe palette are pure colours and do not use dithering, a method of combining different colours in order to get a wider colour range.

Forces:

Colours outside web safe palette are usually considered more attractive, however, web designers may not predict their look on different computers, different platforms (e.g. Macs and PCs), and different browsers.

For created images a restricted palette may be acceptable since the designer has control over the choice of colours, however, this can be a problem when working with photos or scanned images.

Solution:

To be consistent, stick to the web safe palette, regardless of limitations.

Resulting Context:

There is high probability that all potential page users will see the same colours.

Pros:

Web safe colours usually look consistent across all platforms and browsers.

Cons:

Web safe palette is too restrictive.

Corporate colours may be outside the web safe palette (see the Reproduction of Corporate Colours pattern)

Web safe palette gives a choice of only 216 colours.

Even with the *web safe* palette you may still not be *safe*.

2.3 Name: Readability of Text Heavy Web Pages

Problem:

How to minimise user's discomfort on text heavy web pages?

Context:

Text heavy web pages are the ones that require considerable reading time, e.g. information pages.

Readability should be made easier for as many users as possible (or the majority).

Forces:

Black text on white background is commonly used in print and is often the default setting of the web design software; however, brightness of the white background causes the problem for screen readers.

Nowadays web is a primary source of information for many people, so they have to do a lot of reading of text heavy pages, however, it is quite tiring to look for a long time at the large quantity of text in black on white on a computer screen.

Solution:

Reduce the contrast between text and background, e.g. use light-grey background (as recommended by web design guidelines) or use soft pastel colours (which are equally effective).

Resulting Context:

Softer contrast puts less strain on readers' eyes.

Pros:

While the web pages are viewed in softer contrast colour scheme, their printouts are produced by default on white background, thus assuring readability in print.

Cons:

Softening text to background contrast may cause difficulties for visually impaired users.

Related patterns:

“Reproduction of Corporate Colours on a Web Site” – this pattern should be consulted when selecting a background colour to make sure the background colour is in line with the selected colour scheme and existing business stationary. At the same time, the choice of the background may be restricted by “Web Safe Palette”.

Additional advice on the selection of the background for a web page can be found in the “Colour Palette” pattern (Mellor).

The following pattern relate to the 3 previous patterns through colours of the image aspect since the number of colours influences the file size).

2.4 Name: Reducing Image Loading Time

Problem:

How to reduce image loading time on the web?

Context:

Image content for the web site is usually provided by the client. Sometimes a web developer creates additional graphics elements.

Image quality is usually associated with its resolution, size and a range of colours.

All browsers handle 2 image formats: gif and jpeg which use built-in compression algorithms to reduce file size. Some browsers can also handle png format.

Image loading time depends on its physical file size (as determined by the number of colours, number of pixels and compression rate), the speed of an Internet connection, the response time from the server, and the speed of the client machine. The last three aspects are beyond designers' control.

The use of images obscures information for visually impaired people. These users frequently use text readers which ignore images. Text readers only convey image information from the alt tag, if the site is properly designed and such a tag has been included.

Forces:

Usually the project client sends material for a web site and the designer has to select appropriate format and file size for images.

GIF format uses only 256 colours, however it’s designer’s job to decide whether this is sufficient for any particular image.

Download speed is critical to the success of a web site – if clients have to wait too long, they may respond to the site in a negative way or just go elsewhere.

Files should load quickly, but still look good.

High quality images improve the artistic qualities of a web page; however, such images have very large size which reduces the web site performance.

All images take time to load, however, once they are on the client machine they can be cached and may thus not be downloaded again.

While high quality of images is desirable, it should not exceed the capability of the client's machine, as it will unnecessarily increase image loading time.

Solution:

Make image file size smaller by applying the following strategies:

- Make image width and height smaller, thus reducing the number of pixels and resulting in a smaller file size;
- Compress image files - compression does not change image size but could change both file size and the colour palette;
- Use fewer colours in the palette - the fewer colours the smaller the pixel size, and thus the image file size, which results in shorter loading time;
- Use alternative images of different size and quality depending on the resolution of the client's screen and the speed of the connection, as well as, the browser used;

Preload images used as background, pictures and buttons across the website;

Resulting Context:

Applying any of these solutions significantly improves image loading time.

Small loss of image quality, e.g. due to image compression or smaller colour palette, may not be noticeable by the majority of web site users.

Pros:

Shorter image loading time improves the user perception of the web site performance.

Use of the same images across the web site results not only in their shorter loading time, e.g. due to their preloading or caching, but also in consistently looking website.

Using text as alternative or supplement to images (e.g. in menu items) is beneficial for visually impaired users, who rely on text readers or who need to increase the font size.

Cons:

Image compression may cause visible loss in image quality.

Reduction of the number of image colours may also result in loss of quality.

Image caching may not be available on some browsers or when caching is turned off.

Clients who are used to image-based menus most likely will not accept text menus.

Some of the solutions may increase the complexity of the web site design, e.g. the complexity of scripts to determine connection and client machine capabilities and providing alternative or pre-loaded images.

Comments:

Rule of thumb: total size of graphics for a page should be in the 40K to 60K range.

Sometimes designers specify width and height of the image in the HTML image source tag, however that means that original image will be downloaded and resized already on the client machine. It is better if the image is resized using proper editing software by the web designer. In this case the designer will have more control over the image size and quality. Also the designer will reduce the image size before downloading it to the client machine.

JPEG compression algorithm uses a variable compression rate – the higher the compression, the higher loss of quality but designer has a choice and can find some trade-off/balance.

Some image formats, e.g. PNG, provide "lossless" compression which preserves image quality; however, such formats are not fully supported by many browsers.

Pixels on the outside of the image that are the same colour as the web page background can be removed without any visual loss to the image.

A common practice is to use "thumbnails" (small images) to allow previewing of images before displaying them in full size and quality.

Very small images (like little arrows) next to text menu items still look good.

Consider text and vector graphics as alternatives to images.

Related patterns:

Sparing Images (Orenstein 1996) suggests to question the use of every image on the website, i.e. whether this image is adding value to the quality of the website, otherwise the image should be removed.

3. Summary and Future Work

In this paper we presented four patterns dealing with colour and image issues in the front-end web development which are relevant to any project in web site design. These patterns are the result of the multimedia domain-wide mining involving practitioners with no knowledge of patterns and pattern mining. Elicitation of best practices in web development as well as pattern crafting was the responsibility of the ghost writers. The applied pattern mining process provides an opportunity for domain-wide inclusion of practitioners in capturing and sharing of design experience and results in patterns enriched by practitioners with varying scope of skills.

Nowadays with the availability of easy-to-use software for web development many users who lack important web development skills produce their own web pages. These patterns could help such beginners to quickly gain important web design concepts. We also hope that these patterns could be helpful for experienced designers as well.

We also showed that these four patterns are only a beginning of the future patterns language. After conducting additional interviews and involving more practitioners we will be able to enrich existing patterns and produce the missing ones.

Also with rapid development of technology these patterns may need further revisions and enrichment over coming years. For example, one day the web safe palette issue could become obsolete.

4. Acknowledgments

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5. Bibliography

1. Coplien, J.O. (1996): "Software Patterns." New York, New York: SIGS Books & Multimedia.
2. Gaines, B.R. and M.L.G. Shaw (1993): "Eliciting Knowledge and Transferring It Effectively to a Knowledge-Based System." *IEEE Transactions on Knowledge and Data Engineering. 5*(1): p. 4-13.
3. Manns, M.L. and L. Rising (2002): "What Makes Pattern Languages Work Well." in proceedings of *7th European Conference on Pattern Languages of Programs (EuroPLOP 2002)*. Irsee, Germany.
4. Mellor, J. "Patterns Garden." http://www.lancs.ac.uk/postgrad/mellor/, last accessed 21 April 2005
5. Orenstein, R. (1996): "An HTML Pattern Language at Anamorph." http://www.anamorph.com/docs/patterns/index.html, last accessed 21 April 2005

6. Rising, L. (1999): "Patterns Mining," in *Handbook of Object Technology*, S. Zamir, Editor. CRC Press. p. Chapter 38.
7. Wands, B. (2002): "Digital Creativity." Wiley & Sons.