Personalized Preference Metrics for Image Pattern Design

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Abstract

Artistic perception has been regarded as a subject of personal preference, although there are well established mechanisms explaining characteristics of design artifacts. In this paper we have identified problems relating to specification for image pattern designs. Specification scheme has been suggested that can utilize design elements such as forms, shapes, colors, and nine design principles for automatically generated patterns. Personal preference on design is represented by personalized preference metrics supported by scoring systems. Scoring systems have been constructed to demonstrate ideas and effectiveness of suggested scheme.

Keywords: *Design patterns, CGI. Personal preference metrics, Pattern specification*

1. Introduction

Design patterns are results of artistic works which aim to utilize artistic values to commercial products. It has been believed that building design patterns needs professional knowledge and dedicated skills. However, due to the wide spread of authoring tools, individuals become to be able to build design artifacts with reasonably easy skills. Computer based image generation is a typical way of producing digital images. Tools such as Flash Fractal Maker [1], Anvil Graphic Design [2] based on Processing [3] are examples of such category of tools. Automatically generated images bring variety of choices in shapes as well as colors, sometimes in an unexpected way when randomness can be controlled in a proper way.

However, they often raise problems as well in both artistic and practical viewpoints. From artistic perspectives, quality of automatically generated images may not fit into commercial expectation because of their uncontrolled shapes and colors, mainly due to generation algorithms. The second problem is related to management of the image patterns, which this paper focuses on. The problems are two folds: specification of images is difficult because most of automatically generated images tend to be abstract, or geometrically shaped, and thus difficult to make title on them. The heart of naming problem is that most of automatically generated images have no counterpart of their real world analogue. For example, in Figure 1 (a) images has geometric shapes of lines, circles, rectangles which have no resembles in real world entities. Whereas in Figure 1 (b), shapes are familiar because they have real world analogues such as trees. Purely abstract patterns sometimes make problems with retrieving the database. In most cases retrieval processes require text keywords for their search keys which seem irrelevant to abstract images.

Similar to retrieval problems, finding preferred patterns also have naming or description problems since there are no formal way of describing abstract images explaining characteristics of preferred features shown in the desired patterns. People often have personal preference of design images, however it is fairly difficult to describe specifically what make the image appeal to people compare to another. Such difficulty becomes doubled when it comes to automatically generated images with large number of quantity.

(a) Purely geometric images (b) recognizable geometric images

Figure 1. Examples of Automatically Generated Patterns

In this paper, we introduce a specification scheme for design patterns and their rating systems in order to measure design preference on the basis of design elements. The suggested techniques also provide designer with visualization of personal preference on design artifacts. This paper is organized as follows. Section 2 gives basic ideas on the specification techniques for design patterns. In Section 3, scoring systems and ideas of preference metrics are explained and their implementation is introduced. Finally, Section 4 concludes this paper.

2. Specification Scheme

This section describes specification scheme for design patterns by considering design elements and nine design principles as intrinsic features.

2.1 Design Elements

Design elements are key parts of design images, and consist of three parts: forms, colors, textures. Form elements explain visual construction of shapes, structure, and patterns. Within the context of form elements, there are three basic building blocks depending on the connectivity of primitive elements: points, lines, shapes. A point is the smallest and also basic elements. Point may be either a dot, or a mark or a set of dots that makes larger dot. Thus, the concept of point can vary in size, or forms, and rather conceptual perception of dots. A line is a form which has width and length, or starts and ends, whereas shape is an area that is connected by a set of lines. Sometimes shape can be represented as a colored box, where cannot be seen. Forms sometimes come with a volume and mass, and this considered as a three-dimensional. By definition, forms and space can be seen from any angles, but in computer generated images it has to be 2 dimensional. Any images that create a feeling of actual depth, or volume of depth can be classified as forms or space category.

Color has primarily hue values constituting yellow, red, and blue as primary values. Secondary colors can be made from the mixtures of primary colors. Another property of color is value representing lightness and darkness of hue. Finally, intensity of color refers to the purity of colors. Texture is related to the surface feeling of images, such as roughness or smoothness of surface feeling, which simulates surface of actual objects

2.2 Design Principles

Design principles are widely accepted artistic perception of design artifacts relating to forms, color, textures. Design principles differ from design elements in that the design principles are more interested in cognitive perceptions from the overall correlation of design elements such as dynamic or static, unbalanced, or organized, etc, thus psychological impression is important [4, 5]. In this paper we make four categories that encompass design principles.

- *Group 1: Space partition- Division, Composition*
- *Group 2: Dynamics – Repetition, Rhythm, Movement*
- *Group 3: Patterns- Symmetry, Proportion*
- *Group 4: Weight- Brightness, Contrast*

Group 1 represents information on patterns partition of space. Space partition places balance of forms and shapes, arranges design entities to send visual messages. This group is interested in division of space, composition of shapes. Dynamics of patterns can be represented in Group 2. This group focuses on motion or movement of design elements providing the path the eye follows. Group 3 shows geometric characteristics of patterns. This includes symmetry and proportion of design patterns. Finally, Group 4 represents color information mainly about feelings on weight by considering brightness and contrast information. The design information captured in each groups are summarized in the form of radial charts (Figure 2).

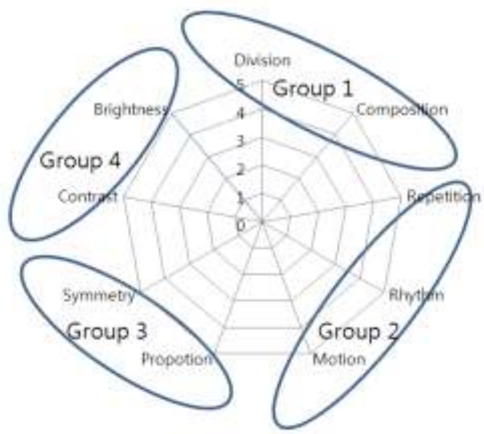


Figure 2. Classification of Design principles

2.3 Specification of Design Patterns

In specifying patterns, we have made some criteria for description of patterns. First, specification should be as simple and objective as possible. Second, specification should contain all information required. And finally, the specification should be extensible for future applications.

The pattern specification consists of three parts; shapes, color, and emotional information. The shape parts reflect design elements and design principles expressed explicitly or implicitly in the pattern. Color parts show dominant color values. Multiple values can be enumerated if neccessary. Emotional information is rather subjective and sometimes varies depending on designer or users. Nevertheless, emotional aspects of the design are important information that can provides users with designer’s intention for the patterns. The syntax of the specification consists of the following elements:

ImageSpec= Shape + ColorSpec + EmotionSpec

ShapeSpec = Forms + Pattern
Forms = {point | line | rectangle | space | .. | user defined shapes}
Pattern = { *Division=*$value_1$, *Composition=*$value_2$, *Repetition=..*, *Proportion* $value_9$}
ColorSpec = *ColorValue*
EmotionSpec = {modern | classic | rural | cold | warm | .. | user defined emotion}

Note, that {} means multiple occurrence of elements, [] for optional information, + for sequential appearance of information, | for selective information. In order to explain the specification scheme, consider the following two cases.

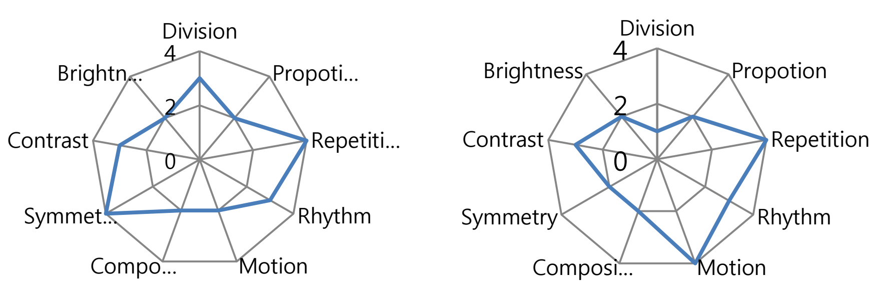
(a) (b)

Figure 3. Example Images for Pattern Specification

As shown in Figure 3 (a), the floral pattern image has repeated patterns in black and red color, with diagonally symmetric structures. Figure 3(b) has, on the other hand, irregular occurrence of patterns with dynamic edges in different directions. These patterns have the following specification, and radial charts showing individual design characteristics.

ImageSpec(image a) = ((Form=Flower_shape, Pattern={Division=2, Proportion=4, Repetition=4, Rythm=3 Motion=3 Composition=4,Symmetry=4,Contrast=5, Brightness=4), ColorValue= (#333333,#990033)))

ImageSpec(image b)=((Form=shape, Pattern={Division=4, Proportion=3, Repetition=4, Rythm=4 Motion=3 Composition=3 Symmetry=3,Contrast=3, Brightness=2), ColoValue= (#CC3366,#CCCC33)))



(a) **(b)**

Figure 4. Radial Charts for Patterns for in Figure 3

The usefulness of radial charts is that the charts can visualize characteristics of patterns from the perspective of design principles. For example, in Figure 4, both patterns have strong occurrence of repeated symbols, Also, we know from the chart that pattern (a) is strong in symmetry and pattern (b) is better in motion criteria.

3. Scoring Systems and Preference Metrics

Scoring systems can mark the target design patterns. The scoring system considered in this paper consists of three parts. Scoring systems has an ability to trace retrieval history of design patterns. When the customers find desired patterns, they put mark depending on their preference scale ranging from 1 to 5 (Figure 2). The system accumulates scores and updates preference tables. Scoring systems have provided designer/customer with information on what kind of patterns they like, and what design principle they are interested. Figure 5 shows how the scoring systems relate to pattern image management systems, and what output can be produced from the systems.

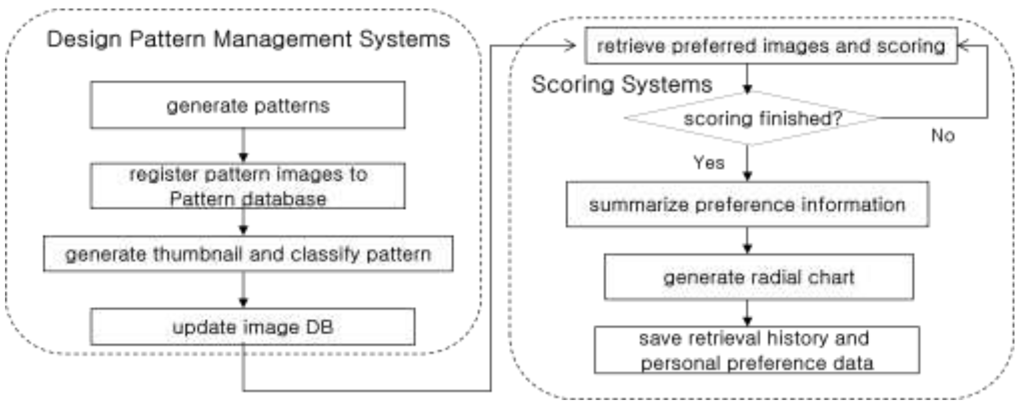


Figure 5. Workflow of Scoring Systems

A personalized preference metric provides a means of presenting quality factors of design preference in a quantitative way. In our approach, nine criteria explain in Section 2 is adapted as a field of the metric. In order to calculate preference metric, the scoring system collects scoring data from the pattern interfaces (Figure 6). Designers or users can mark for each design pattern score ranging 5(most preferable) to 1(least preferable).

Figure 6. Scoring Interface of Preferred Design

The scores from each pattern has input of weighted values, i.e. preference strength of the patterns. All the inputs with preference scores are averaged by the scoring systems, and produces final personalized preference metrics (Figure 7).

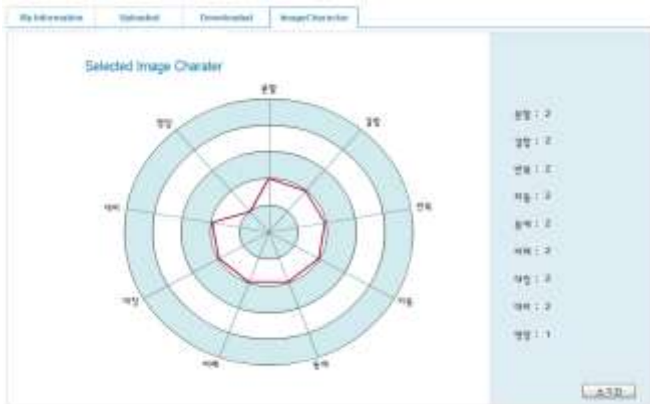


Figure 7. Personalized Summary of Image Preference

The personal preference value set ppv can be obtained from the following equation;

$$ppv = \sum(\sum_{i=1}^{9} pattern\_item_i * weight_i \;)/ n$$

where, $pattern\_item_i$ is i-th pattern elements, $weight_i$ is score for i-th pattern elements, and n is a total number of patterns scored.

Figure 7 shows preference metrics for the patterns shown in Figure 6, if the user selects these patterns as their preferred pattern images. The scoring system and preference metrics enable the user to accumulate history of pattern search, and extract useful information in terms of design principles.

4. Conclusions

In this paper, we have introduced specification schemes for pattern images based on design elements and nine design principles. This approach is particularly effective when automatically generated images are evaluated which are abstract and thus, hard to find proper image names. Also, describing personal preference on the abstract design artifacts is not simple problems because it is often the case people do not point out what constitutes foundation of their artistic aptitude. In order to ease the problem, we adapted personalized preference metrics for pattern images relating them to design principles. Scoring systems that interact with pattern management systems have been implemented to demonstrate the usability of ideas described in the paper.

We believe that image scoring system can be applied to the industrial survey where companies are interested in analyzing customer's preference on commercial designs, such as clothes, fashion accessories, wall papers, where design preferences need to be evaluated.

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