GENERATING WEB TEMPLATE WITH SUITABLE COLORS BASED ON GENETIC ALGORITHM

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Abstract: In this paper, we present a new approach that generates a web template with compatible colors. This approach uses a genetic algorithm. The system generates random colors for each web template. All templates are showed previews on the screen and then the best template is selected by applying the genetic algorithm. It is converted to Html format and is showed on web browser. It is kept in the database for later use.

1 INTRODUCTION

Web pages are communication tools between a web producer and a web user. Many web page designs do not have an aesthetic appearance. If we assume that user is not a web developer and that he needs an automatic tool to make him valuable creative suggestions in order to personalize his site, then standard editors can be useless because they fail to catch the user preferences (Oliver at al., 2002). For this case, it is important to choose an appropriate color and design for an important event, it is crucial to choose appropriate color schemes to convey images and messages on your web page.

This study focuses on the following problem: when creating a site, the user may specify the personalize style of his sites and that more precisely text colors, background colors, fonts, etc. The user can use suitable web templates for web site styles but many of templates have a color compatibility, unsuitable fonts and fonts color.

In this paper, we propose to a genetic web design optimizer for best web page styles. Our study focuses on the optimization of web sites style, i.e. compatibility of font and page background colors.

Genetic Algorithms (GAs) are search techniques used to find approximate solutions. They were formalized in 1975 by Holland (Holland, 1975). GAs deal with a population of candidate solutions for a given problem. Each solution is encoded with in a sequence of genes. GAs consist of main steps. Firstly, an initial population is generated (step1). Then, iteratively each candidate solution gets a score that evaluates its fitness with regard to the problem (step 2).

Then, some solutions are selected (step 3) and reused to generate a new population (step 4). The generation consists in applying operations on solutions (e.g., mutation, inbreeding). Sims (Sims, 1991) applied GA to artistic creation and replaced automatic evaluation with human evaluation. This approach is referred as Interactive GA (IGA) (Takagi, 2001). IGAs lead to new kind of applications in computer science like the reconstruction of a criminal face guided by the victim, or the creation of beautiful images. In those applications, the user selects individuals according to his own criteria and the IGA evolves the individuals according to the user's preferences (Monmarché, 1999). The main drawback of a IGA is the user fatigue induced by the selection of the best individuals over generations. Usually, users can't go beyond 20 generations of 16 individuals (Sims, 1991).

In Human Computer Interaction (HCI), IGA has been explored by Monmarché to generate HTML web pages. In these works, individuals represent Cascading Style Sheets (CSS) (Monmarché, 1999) or CSS plus webpage layout (Secretan, 2008). The population is composed of 12 individuals. Each of them is used to generate a web page. The set of web pages is scaled to fit on a single screen. Individuals can be edited by designers for saving time (e.g., colors customization). At each of IGA iteration,

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designers select best candidates among the 12 web pages.

This study have three main restriction. First, the selectors that identify HTML elements on which to apply CSS transformations are predefined (e.g., titles of level 1, paragraphs, images). It is impossible to generate new groupings along the IGA process (e.g., even paragraphs and images). Second, there is no high level description (e.g., no task model) which the IGA could rely on generating more complex transformations (e.g., replace an entry text with a calendar). Finally, individuals can’t be complexities along the IGA process. Only parameters can be tuned, but no new parameter can be added (e.g., no insertion of text or images to enhance existing elements).

The paper is organized as follows. In the next section, the system description and technology that used are explained. Compatibility criteria of two color and interactive genetic algorithms in user interface design are described in Section 3. Experimental results and conclusions are given in Sections 4 and 5, respectively.

2 MATERIALS

2.1 System Description

Our project is roughly presented in Figure1. It takes a task model in input. It uses a customizable flowchart of GA operations to create and make evolve a population of transformations.

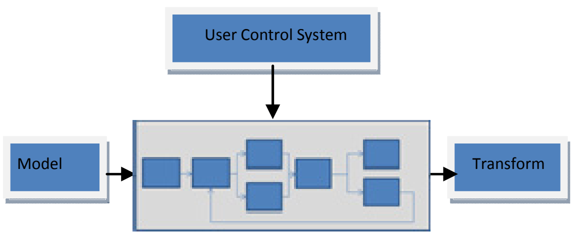


Figure 1: System flowchart.

The user interface of our project is divided into two pieces: a workflow editor and a web based user interfaces for exploring the design based on IGA. The workflow editor is composed of two parts: on the left, general control system is located in the menus. At the center, a wizard is dedicated to build the workflow. Steps of wizard: The user selects a predefined HTML template. It is based on web standards. Then user determines the values of genetic algorithm operators. The wizard generates web templates with random colors. All templates are showed preview on the screen. The most harmonious color web template is selected with the genetic algorithm applied with the necessary procedures. This template is kept in the database for later use.

2.2 Technological Choices

This study is based on the Java Enterprise Edition (Java EE) platform. Java EE is a web profile to create next-generation web applications. We have used Java Server Faces (JSF) on the based Java EE. Java Server Faces (JSF) is a Java-based web application framework intended to simplify development integration of web-based user interfaces. For support JSF, we have used Eclipse IDE tool.

3 METHODS

3.1 Use of Color

Color is an important asset in the design of Web content, enhancing its aesthetic appeal, its usability, and its accessibility. However, some users have difficulty perceiving color. People with partial sight often experience limited color vision, and many older users do not see color well. In addition, people using text-only, limited-color or monochrome displays and browsers will be unable to access information that is presented only in color (Web content accessibility guidelines 2.0, 2007).

3.2 Determining Colour Visibility

Colour Visibility is based on two sets of algorithms: Luminosity Contrast Ratio and Color Difference-Brightness Difference, suggested by the World Wide Web Consortium (W3C).

Contrast Ratio Formula: The contrast ratio is determined by the formula 1.

Measure the relative luminance of each letter (unless they are all uniform) using the formula 1.

$$L = 0.2126 * R + 0.7152 * G + 0.0722 * B \quad (1)$$

where R, G and B are defined as:

if RsRGB <= 0.03928 then
R = RsRGB/12.92 else
R = ((RsRGB+0.055)/1.055) ^ 2.4

if GsRGB <= 0.03928 then
G = GsRGB/12.92 else

G = ((GsRGB+0.055)/1.055) ^ 2.4

if BsRGB <= 0.03928 then
B = BsRGB/12.92 else
B = ((BsRGB+0.055)/1.055) ^ 2.4
and

RsRGB, GsRGB, and BsRGB are defined as:
RsRGB = R8bit/255
GsRGB = G8bit/255
BsRGB = B8bit/255

The "^" character is the exponentiation operator.

Color Brightness Formula: Color brightness is determined by the formula 2.

((Red value X 299) + (Green value X 587) + (Blue value X 114)) / 1000 (2)

The difference between the background brightness, and the foreground brightness should be greater than 125.

Color Difference Formula: Color difference is determined by the formula 3.

(max(Red1,Red2) min(Red1,Red2)) +
(max(Green1,Green2) min(Green1,Green2))+ (3)
(max(Blue1, Blue2) min (Blue1, Blue2))

The difference between the background colour and the foreground colour should be greater than 500.

Two colors provide good color visibility or good color compatible if the contrast-ratio and brightness difference and color difference between the two colors are greater than set ranges. These ranges are listed in below.

- Brightness Differences > 125
- Color Differences > 500
- Contrast Ratio > 4.5

3.3 Interactive Genetic Algorithm in User Interface Design

Firstly individuals are described that were generated for system. Then describe the components: initialization of the population, genetic operations, evaluation and selection.

Individuals encode a set of web templates. The structure of each template is associated with standard HTML template. We decorate individuals with random colors. For instance, in Figure 2, each template was created for the background and font (text) color. We encode the user interfaces representation in chromosomes. As shown in Figure 2, every color in the chromosomes represents a gene. Appearance gene of each part was encoded by decimal number as RGB (255,255,255).

Initialization has to deal with two concerns: the size of the population, and the generation mechanism. The size of the population is crucial: if too small, there is a risk to converge towards "bad" or undesired solutions; if too large, evolution of solution becomes time consuming. Pic breeder (Secretan, 2008) shows that it is possible to obtain good results with 16 elements. In this study, the size of population is a variable parameter.

We have used random generation mechanism for initializations. Individuals are randomly generated by system.

Selection of individuals, several selection methods exist in the literature. One can cite steady-state selection or roulette wheel selection (selection probability proportional to the score). Elitist strategies may be applied. They consist of keeping the best individuals unchanged through generations in order to avoid regression.

Figure 2: Chromosome structure.

3.4 Fitness Function

In fitness function, we compute the similarity between two individuals. It calculates color similarity of two user interfaces, in term of the font and background color. To determine color similarity, we calculate color difference (***l(x)***) and brightness (***k(x)***) between two colors. The average of background and font color of each column, fitness in formula 4 was used as convergence measurement, which is shown as follow:

$$fitness = \sum_{i=1}^{n/2} \sum_{j=1}^{n} (k(j) + l(j/3) - m) \quad (4)$$

where m is the threshold value. It is equal to 60% as default.

4 EXPERIMENTAL RESULTS

In this study, we determined default values of GA's parameters on Table 2. We have tested our study using single-point crossover and 8 colors. As the first step to generate 20 individuals with randomly as shown Figure 3. Each individual is consisted of four parts (header, sidebar, content, footer) and each part is used two colors (background color, foreground color).

Table 1: Default values of GA's parameters.

Paramaters	Default value
Number of Populations	20
Size of Generations	1000
Probility of Crossover	0.7
Probility of Mutations	0.01
Number of colors	6 or 8
Type of Crossover	0 or 1

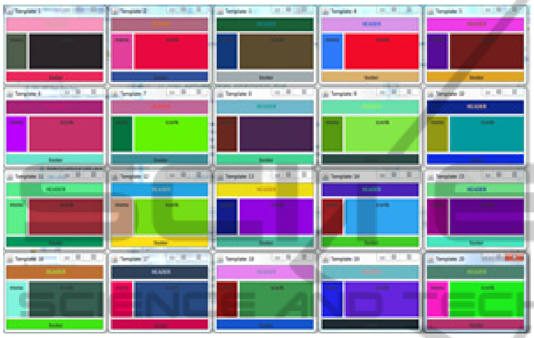


Figure 3: First Population.

Experimental results are presented in Table 3 and Figure 4. Figure 4 compares to minimum, maximum and average fitness values with the different number of individuals. These data were obtained by running the genetic algorithm on five times for each cases.

Table 2: Fitness values according to number of individuals.

Number of Inviduals	Min Fitness	Max Fitness	Avarage Fitness
10	- 201,91	10,21	- 30,13
20	- 199,68	17,18	- 29,05
30	- 167,38	40,12	- 13,43
50	- 130,23	35,89	1,65
100	- 60,12	58,91	13,39
200	1,12	71,56	37,28
300	14,67	69,89	43,69
500	28,46	83,98	57,16
800	39,97	93,68	67,89

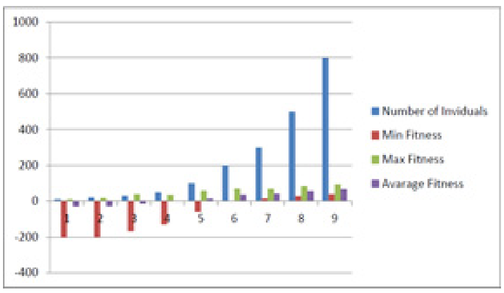
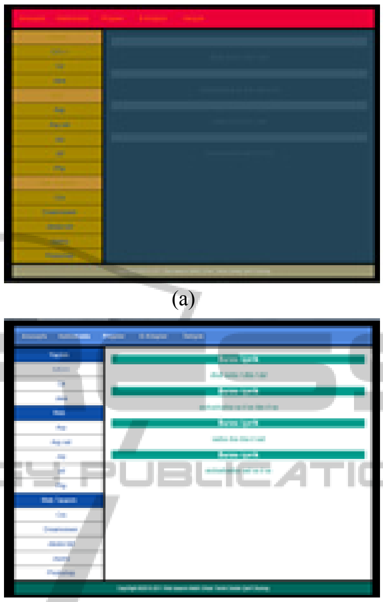


Figure 4: Charts of the test results.

Fitness function value can changes between -250 and 160. In figure 5(a) and figure 5(b) is generated at the end of the genetic algorithm. In figure 5(a), fitness value is -79.45 and it is worst template. In figure 5(b), fitness value is 29.71 and it is the best template.



(a)

(b)

Figure 5: The worst(a) and the best(b) template.

5 CONCLUSIONS

We have studied the generating best web template based on genetic algorithm. In this study, we suggested a new fitness method applying genetic algorithms. Our fitness function is approached 85% of the maximum fitness value.

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