Research and Extraction on Intelligent Generation Rules of Posters in Graphic Design

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Abstract. With the advent of the intelligent era, artificial intelligence has gradually played an important role in the generation of design. That's why it is particularly essential that how to use artificial intelligence to make a design output. This study aims to explore the rules of machine-generated graphic design. Take the intelligently generated film poster as an example, designers use professional knowledge to train the machine for multiple rounds and evaluate the machine-generated results. Then explore and improve the machine intelligently generated film poster for multiple rounds to let the machine generate movie posters which fit the public's aesthetic. In the end, through the evolution of designers, we determined the measurement dimension of aesthetic. We also summarized several important rules for machine-generated movie posters and design, as well as provided reference for machine-generated graphic design and human-machine cooperation design in the future.

Keywords: Machine learning · Graphic design · Universal aesthetics

1 Introduction

The roots of artificial intelligence in the 50-ies and 60-ies AI lab of the MIT [1]. In general, it is not a very new technology. In recent years, artificial intelligence technology has been widely used. Similarly, the demand for design in various industries is expanding, for example, it has already been designed using artificial intelligence technology especially in the field of applied graphic design, such as packaging, books, advertising posters, and website banners, etc. [2]. Thus, the designers are freed from the original production chain and become a role of summary whilst the machine is doing a design.

In order to make artificial intelligence better for design, this paper takes the intelligently generated poster design as an example to explore the rules of machine intelligent generation of graphic design. The artistic and aesthetic goals in the poster design are quantified as measurable rules, and through the evaluation of the

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intelligently generated posters by the designers, the evaluation criteria finally summarized into five dimensions.

Through the exploration of the rules, the efficiency of designing with artificial intelligence can be improved. And evaluating the final design output can also facilitate the design cooperation between designers and machines at this stage. What's more, shift from research design to research machine support, use rules to train more intelligent machines efficiently and quantify the steps of working with machines can lower the threshold for using machine learning. Thus through design, everyone can use artificial.

2 Inquiry

2.1 Participants

In this study, we have 5 designers, 100 participants in the aesthetic assessment and 6 developers familiar with artificial intelligence algorithms. The age ranges from 20 to 48 years old.

2.2 Inquiry Arrangements

Currently most of the systems that acquire images with aesthetic value need human judgement. These can be grouped into The search for a general, or universal, sense of aesthetics, and learning from examples of human judgments [3]. The whole study is divided into three rounds of inquiry. In the first round of inquiry, we asked the five designers to conduct a desk research of the existing poster design to analyze the design rules of the poster combining with the previous literature, Intent to find a general aesthetic. Then we imported the rules into the machine to further help the machine learn from human judgment, and evaluated the final machine-generated posters. The second round consists of two parts: rule adjustment and aesthetic assessment. In the third round, we improved the rules and established the evaluation criteria of aesthetic assessment based on the previous results of public aesthetic assessment to help improve and perfect the rules. In the meantime, the training machine continues to improve itself (Fig. 1). Because exploration and refinement are critical and complementary tasks in design [4].

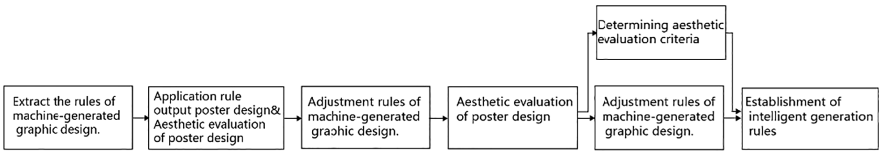


Fig. 1. Experiment process

2.3 Inquiry

The First Round of Inquiry. The poster design rule extraction phase. We searched more than 100 literatures, downloaded and sorted out more than 2,000 movie poster designs. Then we extracted and refined the layout rules, the hierarchy of movie posters and color classification and matching [5].

Layout Rule Extraction. We used the grid system to summarize and explore the layout of the movie posters in the following six dimensions, and finally generate the rules of eight types of layout. 1. The spatial position of the layout image. 2. The size of the space of the layout image. 3. The combination relationship and separation form between the various parts of the layout image, the main image and the accompanying image. 4. The combination relationship and separation form between the layout image and space. 5. The visual impact and power generated by the layout image. 6. The form of beauty law and aesthetics produced. The final result is a style specification rule for six types of layouts (Fig. 2).

Poster Layer Classification and Rule Extraction. Then we classified the layer of poster design further, which is mainly divided into background elements, theme objects, text elements, and decoration elements. What's more, the background elements were divided into colored background (including a single color, a gradient color, a repeating texture, a color block combination, a multi-color pattern, etc.) and scene background (the subject-related background and the general-purpose background) (Fig. 3).

Color and Style Rules Extraction. There exist universally for humans eleven basic perceptual color categories [6]. Based on the hue, color, brightness and purity of the poster color, we did color division and matching for the final generated movie poster. At the same time, taking the use of the poster into account, summary of the overall color matching (Fig. 4).

Aesthetic Assessment. To build learning models one can focus on the judgments of a single person or attempt to get aggregated judgments for a number of people [3].

We firstly invited 30 participants to evaluate the satisfaction for 600 posters produced by the machine. Secondly, we asked the participants, including14 males and 16 females, aged from 20 to 48 years old to rate the poster on the Likert-Scale [7], the score of which is ranging from 1 (very bad) to 5 (very good). Related scholars and others suggest that people's emotional reactions should be used as a source of evaluating the artistic and aesthetic works [8]. So we encouraged participants to use an adverb with an adjective description to think aloud the reason for the score. And we conducted a statistical summary of the high-frequency descriptive words in the oral reports. The participants who used the evaluation was interviewed in order to judge the specific attitude of the user towards the machine-generated poster. Finally, five criteria for the public aesthetic assessment were concluded.

Summary. We summarized and sorted the ten keywords that appeared the most frequently in the oral description of the participants. Key word1 was the keyword that appeared the most frequently, and key word was the tenth keyword that appeared the most frequently. participants' comments on the poster with a score of 1 are mostly "the

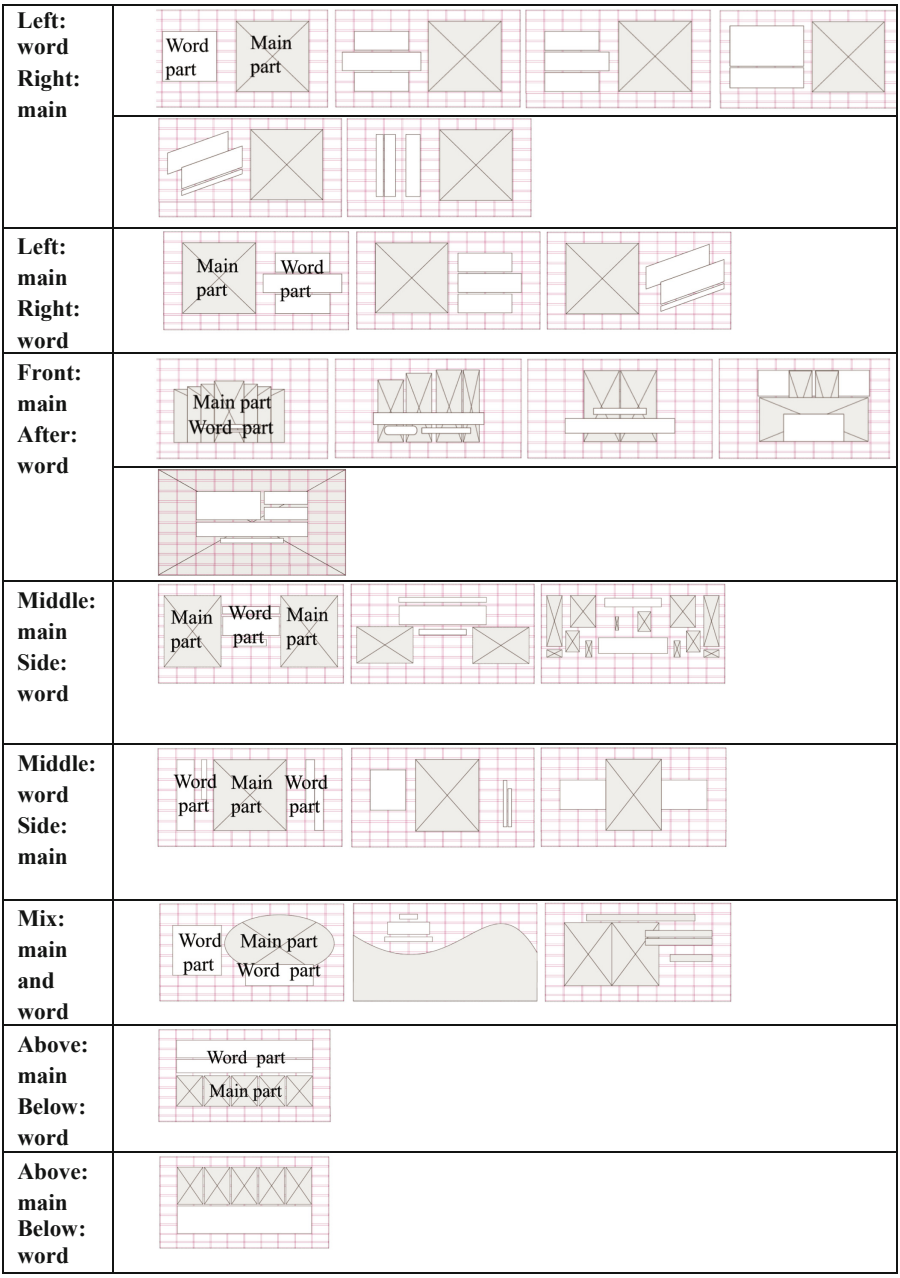


Fig. 2. Types of layouts

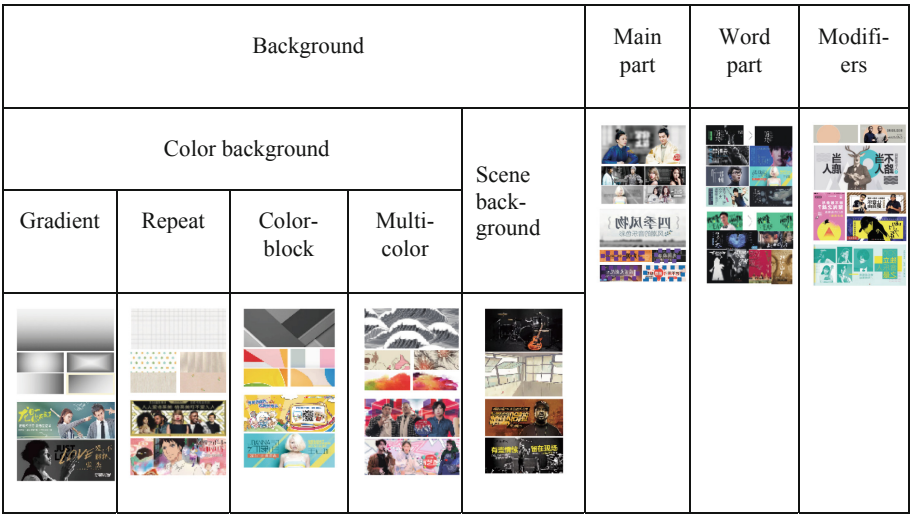


Fig. 3. Classification and extraction of poster layer (Color figure online)

content cannot be separated from the background", "it's too big", "it's a little close", "it doesn't look good", "it's not focused", and so on. In the score 2, the most common words are "too flowered", "unclear words", "strange position", "too scattered", "a little ugly", etc.; Most of the score 3 comments are "just ok", "a little messy", "gaudy", "strange", "just mediocre" etc. The most common words in grade 4 are "a little bit good-looking", "better", "a little bit gaudy", "not bad", "like this" and so on. Most of the words in score 5 are "nice", "perfect", "bravo", "so great", "reasonable" and so on. Through the interview and summary after participant rating, the posters generated by the machine are finally divided into the following five grades: the fifth grade is the best, and the first grade is the worst. In order to improve the effect of machine generated posters, we finally took the level 5 and level 4 posters as qualified posters. Based on this, the generation rules of the input machine are modified and improved (Table 1).

The Second Round of Inquiry. We further summarized the previously complex rules. The rules are adjusted according to the recognition rules generated by the machine and the participant's oral description (Fig. 5).

For the "cannot be separated", "a little messy", "too scattered" and other issues were adjusted. Instead of stratifying the characters and background of the poster, we used the stills of the film to generate the poster. We classified films according to content intention, and explored the matching rules of serif, non-serif and other types of font styles [9]. Then we corresponded different fonts in different types of films to maintain the unified style of the final poster (Table 2) [10].

At the same time, in order to make better use of the following rules in other graphic design, we have sorted the content elements in poster design according to their importance. The most important are the first level, then the second level, and so on. In the design of the movie poster, the first level content is the background of the stills. The second level content is the main character and the third level content is the name of the film. The fourth

Color		Match	Mood board
Red			Dangerous bloody powerful majestic ...
Brown			Vicissitude nostalgic martial arts ...
Orange			Endurance warm ignorant dull ...
Yellow			Happy logical innovative spiritual hopeful ...
Green			Natural vital youthful monetary quiet ...
Light blue			Peaceful cold depressed sad lonely ...
Dark blue			Calm intelligent loyal safe masculine brave ...
Purple			Aristocratic luxurious ambitious mysterious moody ...

Fig. 4. Color classification and matching and corresponding intention (Color figure online)

Pink			Sweet happy feminine weak immature ...
Black			Authoritative dead evil frustrated painful desperate ...
White / Gray			Pure Clean sacred pale solemn ...

Fig. 4. (*continued*)

Table 1. Evaluation keywords and ranking of posters of different levels by participants

	Key word 1	Key word 2	Key word 3	Key word 4	Key word 5
Score 1	Cannot be separated	Too big	A little close	Not good	Not focused
Score 2	Too flowered	Unclear	Strange position	Too scattered	A little ugly
Score 3	Just ok	A little messy	Gaudy	Strange	Just mediocre
Score 4	A little bit Good-looking	Better	A little bit gaudy	Not bad	Like this
Score 5	Nice	Perfect	Bravo	So great	Reasonable

level content is the introduction of the film and the fifth level content is other elements, such as the information of winning awards, starring information and so on.

Comments aimed at participants include “unclear”,” blocked face “ and “too scattered”. For each of the five levels of content, we explored areas where the level of content could not be placed in the entire poster, for instance, the background subject protection area, the edge protection area and so on (Fig. 6).

In response to participant comments such as “too gaudy” and “too flowered”, we added a mask for the poster according to the classification of the film content to unify the tone of the whole picture (Fig. 7).

Fig. 5. Machine identification of characters in the background of the poster

Table 2. Matching rules between different types of fonts and different types of movies

Style	Fonts
Science fiction, action	Serif, Decorative font
horror, suspense	Decorative font, Calligraphy font
Youth, love	Serif, Handwritten font, Decorative font
Comedy, cartoon	Sans-serif, Decorative font
Kung Fu	Serif, Handwritten font
War, Sci-Fi	Sans-serif, Calligraphy font

Serif	Chinese	SimSun	FangSong	NSimSun
		KaiTi	STFangsong	STZhongsong
	English	Bookman old style.	Baskerville	Times New Roman
		Caslon	Courier	
Sans-serif	Chinese	SimHei	Lantinghei SC	STHeiti
		Microsoft Yahei	Microsoft JhengHei	PingFang SC
	English	Helvetica	Formata	Din
		Frutiger	Verdana	
Others	special design	Decorative font（word and shape combination）		
		Handwritten font（free writing）		
	Calligraphy font	Calligraphy font		
		Brush font		

About aesthetic assessment, we input the modified rules into the machine again, and generated 600 different movie posters. Once again we invited the previous 30 participants to score the movie posters generated by the machine and to give oral reports on

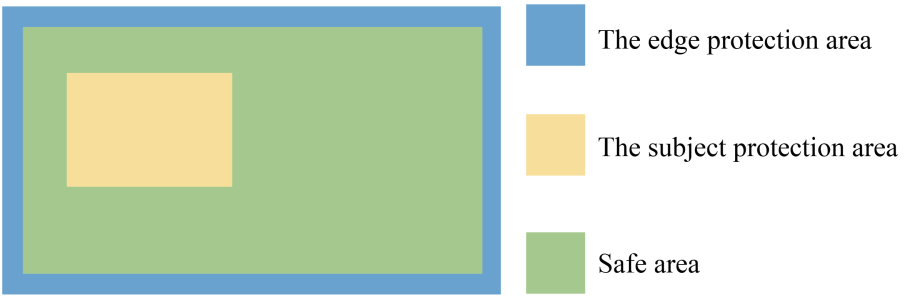


Fig. 6. Area exploration of second level content

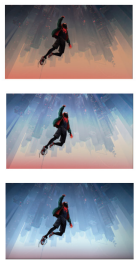
Back-ground style	Science fiction、action	horror、suspense	Youth 、love	Comedy 、cartoon	Kung Fu
Filter style	 ...	 ...	 ...	 ...	 ...

Fig. 7. Filter effect matching content style

Table 3. Participant score results for 600 posters

Scores	Numbers
Score 1	41
Score 2	39
Score 3	120
Score 4	202
Score 5	198

the five-point Likert-Scale. In this poster generation result, we got 402 posters that were rated as score 4–5 by participants (Table 3). But some participants still mentioned problems such as “too much separation of text messages”.

The Third Round of Inquiry. In response to the questions raised by the participants, we tried to combine the text information. Combine the three levels of content and the

four levels of content into the same level of content, and give several combination templates for machine reference and learning (Fig. 8).

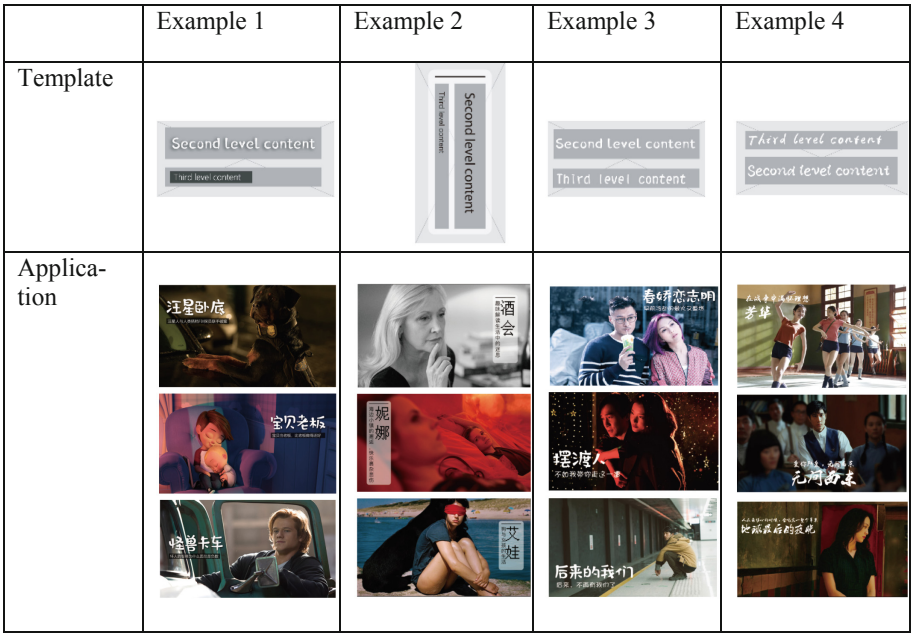


Fig. 8. Third and fourth level content combination templates and applications (Color figure online)

Although creating a new design is more artistic, creating a series of designs with public aesthetic significance must conform to some measurable rules [11]. So we established the standard of public aesthetic assessment according to the classification and corresponding description of the previous two participants' aesthetic assessment of posters. First of all, we determined the evaluation criteria of the five levels, and then chose the fifth and fourth levels, which were ranked highly, as the eligibility criteria for the machine generated posters.

Through analysis, we summarize the criteria for public aesthetic assessment. It can be concluded that only posters that meet the following requirements can be classified into the fifth level: the characters in the background are not blocked. The text and other elements are clear. The overall picture is harmonious in tone with a gathering and dispersing relationship and prominent theme. The fourth level is slightly worse compared with the fifth level. It should meet: the characters in the background is not obscured. The text and other elements are clear. The overall picture is tonal harmony, accumulation and dispersion relations or outstanding theme. The third level should meet the characters in the background is not obscured, clear text and other elements. The overall picture is tonal harmony or have a relationship between accumulation and

dispersion or outstanding theme. The poster of the second level is the one in which the characters in the background are not blocked. The text and other elements are clear. The overall picture is harmonious in tone. And there is a gathering and dispersing relationship. The theme is prominent. The first level is a poster that meets only a little of the five criteria.

Finally, we invited a participant from an advertising company who had participated in the scoring to conduct a full-process intelligent graphic design generation experience, and described the feelings after using it. Further ensure that our rules also meet the participant's requirements in the final use.

3 Results

The first round of exploration is to split and recombine every element in the poster to build a suitable poster design. Rules are made and explored by exploring the overall layout, background, main object, text information, decoration and color of the poster. Furthermore, the rules are used to generate posters for evaluation.

According to the feedback of participants' aesthetic assessment, the second round of inquiry changed the extraction of background and character elements into still background and combined them with other elements to generate the final poster. Meanwhile, it matched the font and the corresponding poster scene and added the auxiliary effect of mask. That is to determine the background, to determine the style of the text, and then to the layout planning, and finally the color tone of the unified step. In order to adapt to the graphic design-oriented poster design, in the second round of exploration, all the elements in the poster were divided according to their importance. The use of rules is simplified by dividing the most important level of content into the least important level of content.

Finally, through the perfection of the third round of exploration, we conclude that the final rule extraction should be the determination of the first-level content, such as the determination of the background; Second content such as text style collocation; Third levels of content such as text color style collocation. Fourth level is matching of other elements such as actors and crew; The fifth level is the determination of the overall tone of the mask. Finally, the aesthetic assessment criteria can be used to evaluate the aesthetics of the poster using the rules, so as to ensure the quality of the final output.

4 Conclusion

Due to the increasing demand for design in various industries, the original design method and cost can no longer meet the existing design requirements. This paper proposed a rule based on artificial intelligence generating design to reduce the burden on designers. At the same time, intelligent rule extracting reduces the threshold for users to use graphic design and artificial intelligence technology which contributes to meet the design needs of all walks of life and the popularity of artificial intelligence. When using this rule, the user can not only control the elements in the graphic design,

but also select and control the final output design style in the early stage. In addition, the designer can also use the graphic design generated based on the rule as a basis of his own design, and make further modifications and adjustments if he need. From a broad perspective, the exploration process and formulation of the rule can be applied to other areas where artificial intelligence and designers collaborate.

5 Future Work

The experimental study in this paper is limited to applied film poster and graphic design, so there are still several problems to be solved. First of all, when selecting posters for summary, most of the posters we chose are online applied posters, that is, they focus more on the expression and presentation of content and lack diversified artistic effects. Secondly, there are only a limited number of fonts we can match, so there should be more fonts that can be applied to the poster, which may also have an impact on the final rule we summarized. There is also much more work to be done to help us explore the details of machine learning to generate graphic design rules.

- analyze and summarize more artistic posters and designs to add diversity and artistry to the final graphic design.
- design and compare more different machine generation approaches to refine current rules from more different perspectives.

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