Aesthetic Evaluation of Interface of Music Apps Based on Aesthetic Calculation

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ABSTRACT

This study selects balance, order, simplicity and proportion for quantifying to propose a comprehensive aesthetic calculation method for the layout of interface which verified by the music apps.

Keywords: Interface design, Design evaluation

INTRODUCTION

Human-machine interface is the way for users to interact with machines, and its aesthetics have the most direct impact on user experience and work efficiency. In the quantitative search for aesthetics, Ngo proposed 13 measurement indicators to objectively evaluate the interface aesthetics, but the indicators are too high. At the same time, the influencing factors and weights among the indicators are not easy to calculate. Zhou Lei. constructed four interface aesthetic intention structures, and determined their eigenvalues and contribution rates through factor analysis. This paper selects four beauty indicators that affect the layout of interface elements: balance, sequence, simplicity, and proportion, quantifies them, and proposes a comprehensive beauty calculation method for the layout of interface elements. And combined with the subjective evaluation of music apps to verify its objectivity and accuracy, and to guide and improve the interface design.

THEORY

After user interviews and designer focus, combined with the characteristics of interface layout design, four relatively objective beauty indicators of balance, sense of order, simplicity and proportionality were selected as the evaluation indicators of interface beauty for quantification.

Measure of Balance

Balance refers to the distribution of visual quality in an image, that is, the sense of difference created by the contrast between different objects.

Calculated as follows:

$$BM = 1 - \frac{|BM_{vertical}| + |BM_{horizontal}|}{2} \in [0, 1] \tag{1}$$

BM vertical, BM horizontal represents the horizontal and vertical balance respectively

$$BM_{vertical} = \frac{w_L - w_R}{\max(|w_L|, |w_R|)} \tag{2}$$

$$BM_{horizontal} = \frac{w_T - w_B}{\max(|w_T|, |w_B|)} \tag{3}$$

$$w_j = \sum_i^{n_j} a_{ij} d_{ij} \quad j = L, R, T, B \tag{4}$$

Among them, L, R, T and B represent left, right, up and down respectively; a_{ij} is the area of object i on side j; d_{ij} is the distance between the center line of the object and the frame; n_j is the total number of side objects.

Measure of Sequence

Sequence in the interface refers to whether the arrangement of elements in the interface conforms to the movement habits of the human eye. The calculation formula is as follows:

$$SQM = 1 - \frac{\sum_{j = UL, UR, LL, LR} |q_j - v_j|}{8} \in [0, 1] \tag{5}$$

$$\{q_{UL}, q_{UR}, q_{LL}, q_{LR}\} = \{4, 3, 2, 1\} \tag{6}$$

When w_j is the largest in w, v_j takes 4,
When w_j is the second largest among w, v_j takes 3,
When w_j is the third largest among w, v_j takes 2,
When w_j is the smallest among w, v_j takes 1.

$$w_j = q_j \sum_i^{n_j} a_{ij} \quad j = UL, UR, LL, LR \tag{7}$$

$$w = \{w_{UL}, w_{UR}, w_{LL}, w_{LR}\} \tag{8}$$

UL, UR, LL and LR represent the upper left corner, upper right corner, lower left corner, and lower right corner respectively; a_{ij} is the area of the object i in quadrant j. Each quadrant is weighted with q as the standard.

Measure of Simplicity

Conciseness refers to whether the arrangement and combination of interface elements are conducive to user reading and understanding. The calculation formula is as follows:

$$\text{SMM} = \frac{3}{n_{\text{vap}} + n_{\text{hap}} + n} \in [0, 1] \tag{9}$$

Where n_{vap} and n hap are the number of alignment points in the vertical and horizontal directions, respectively; n is the number of interface elements.

Measure of Proportion

Proportion refers to whether the proportion of interface elements conforms to the aesthetic proportion. The calculation formula is as follows:

$$\text{PM} = \frac{\left|\text{PM}_{\text{object}}\right| + \left|\text{PM}_{\text{layout}}\right|}{2} \in [0, 1] \tag{10}$$

$$\text{PM}_{\text{object}} = \frac{1}{n} \sum_{i}^{n} \left(1 - \frac{\min\left(\left|p_j - p_i\right|, j = sq,\ r2,\ gr,\ r3,\ ds\right)}{0.5} \right) \tag{11}$$

$$p_i = \begin{cases} r_i & \text{if } r_i \leq 1 \\ \frac{1}{r_i} & \text{otherwise} \end{cases} \tag{12}$$

$$r_i = \frac{h_i}{b_i} \tag{13}$$

$$PM_{\text{layout}} = 1 - \frac{\min\left(\left|p_j - p_{\text{layout}}\right|, j = sq, r2, gr, r3, ds\right)}{0.5} \tag{14}$$

$$p_{\text{layout}} = \begin{cases} r_{\text{layout}} & \text{if } r \leq 1 \\ \frac{1}{r_{\text{layout}}} & \text{otherwise} \end{cases} \tag{15}$$

$$r_{\text{layout}} = \frac{h_{\text{layout}}}{b_{\text{layout}}} \tag{16}$$

Where b layout and h layout are the width and height of the layout. p_j represents the degree of agreement of the element j with the following ratio.

$$\{p_{\text{sq}}, p_{r2}, p_{\text{gr}}, p_{r3}, p_{\text{ds}}\} = \left\{\frac{1}{1}, \frac{1}{1.414}, \frac{1}{1.618}, \frac{1}{1.732}, \frac{1}{2}\right\} \tag{17}$$

Among them sq, r2, gr, r3 and ds represent square, square root of two, golden rectangle, square root of three, and double square respectively.

Comprehensive Beauty Calculation

This paper uses the characteristic value of each index obtained by the interface beauty factor analysis as the weight of each index to calculate the comprehensive beauty value (As shown in Table 1).

INSTANCE VERIFICATION

This experiment uses five popular apps in the current music APP market: QQ Music, NetEase Cloud Music, Kuwo Music, Migu Music, and Xiami Music. The initial home page interface is shown in the Figure 1.

Table 1. Factor analysis of the image of interface aesthetic evaluation (Adapted from Zhou Lei, 2013).

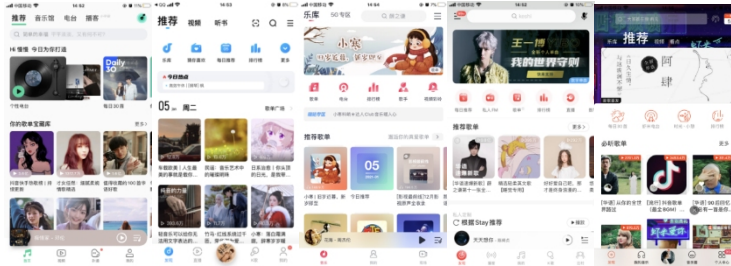| Factor indicator	Eigenvalues	Contribution %	Cumulative contribution rate %
Measure of Balance	6.334	42.267	42.267
Measure of Sequence	3.657	24.403	66.670
Measure of Simplicity	1.826	12.185	78.855
Measure of Proportion	1.178	7.861	86.761

Figure 1: From left to right: QQ Music, Kuwo Music, Migu Music, NetEase Cloud Music, Xiami Music. (Screenshot of the author, 2021).

Figure 2: Picture 2, from left to right: QQ Music, Kuwo Music, Migu Music, NetEase Cloud Music, Xiami Music. (Decolorized by photoshop).

In this experiment, the influence of color and text on the beauty of the overall interface layout is not considered, the interface is decolorized and simplified, the interface elements are divided into title bar, information bar and song playback bar according to their functions, and the functional blocks are abstractly represented as Minimized rectangle that can contain its inner elements, and use different colors to distinguish different elements, the title bar uses the highest grayscale, the information bar uses the lowest grayscale, and the song playback bar uses medium grayscale. The processed image is shown in Figure 2. The X coordinate, Y coordinate, total width w, total height h of the starting point of the rectangle, the total width W of the overall layout, the total length H, and six parameters are used to realize the spatial positioning of the graphic element in the overall interface; The interface is from left to right, and the positive direction of Y is from top to bottom. As shown in table 2. The comprehensive beauty calculation is arranged in descending order of score: interface 1> interface 2> interface 3> interface 4> interface 5, as shown in Table 3.

The survey shows that the age structure of users of major music lapps tends to be younger, and college students are the main group currently using music

Table 2. Positioning values of interface elements, from top to bottom: QQ Music, Kuwo Music, Migu Music, NetEase Cloud Music, Xiami Music.

Layout	Object	X	Y	w	h
Fig1(43.82x77.89)	1	1.64	2.94	40.43	3.88
	2	1.64	7.88	40.43	3.1
	3	1.64	15.99	40.43	12.91
	4	1.64	38.15	40.43	29.14
	5	1.64	67.29	40.43	4.66
	6	0	71.94	43.82	5.95
Fig2(43.82x77.89)	1	1.56	4.1	40.75	4.34
	2	1.56	12.47	40.75	2.9
	3	1.56	20.82	40.75	6.24
	4	1.56	34.69	40.75	36.62
	5	0	71.31	43.82	6.59
Fig3(43.82x77.89)	1	1.56	2.62	40.01	3.49
	2	1.56	7.59	40.85	14.18
	3	1.56	23.93	40.85	5.55
	4	1.56	42.84	42.25	25.08
	5	0	67.92	43.82	4.76
Fig4(43.82x77.89)	1	11.71	2.41	40.43	4.02
	2	1.71	8.44	40.43	15.80
	3	0	25.95	43.82	4.86
	4	0	39.67	43.82	18.98
	5	0	67.8	43.82	5.62
	6	0	73.43	43.82	4.47
Fig5(43.82x77.89)	1	0	0	43.81	29.54
	2	2.13	2.73	39.65	3.25
	3	4.1	31.3	34.3	5.61
	4	2.13	44.85	38.88	27.94
	5	0	72.79	43.82	5.1

Table 3. Comprehensive beauty calculation results for the interface layout from left.

Sample	1	2	3	4	5
Measure of Balance	1.2139	1.2979	1.0827	1.0872	0.8890
Measure of Sequence	0.7500	0.5000	1.0000	1.0000	1.0000
Measure of Simplicity	0.2143	0.2500	0.2500	0.2000	0.2308
Measure of Proportion	0.5990	0.7859	0.2991	0.3756	0.5970
Aesthetic Calculation	11.5283	11.4320	11.3238	10.4660	10.4126

apps with a high penetration rate. Therefore, the subjects in this experiment selected 39 non-design art college students aged 21–26, and asked them to compare five grayscale images after processing, and arrange them from high to low according to their beauty, so as to obtain the relative advantage ranking of its beauty. The results are shown in Table 4, in descending order

Table 4. Subjective evaluation of the layout of five music App interface elements.

Sample	Average composite score
1	3.44
2	2.79
3	2.74
4	2.54
5	2.46

of votes: Interface 1 > Interface 2 > Interface 3 > Interface 4 > Interface 5. Therefore, the subjective and objective evaluation results are consistent.

CONCLUSION

In this paper, a comprehensive beauty calculation method is proposed and verified by experiments. The difference in subjective scores of some interfaces is not large, which may be related to the similarity of the partitions caused by the similarity of the main functions of the existing apps. Due to the individual differences in aesthetics, apps should start from flat, pay attention to the clear boundaries of the layout and easy retrieval, and on this basis, the stylization of the interface should be improved as much as possible to show distinction.

REFERENCES

Chang Yutian., Jiang Subaru., Hu Zhongfang., Wang Zirui., Liu Chaozhou., and Guan Weiyu., 2020. Analysis and evaluation of music apps. Computer Knowledge and Technology.

Ngo, D.C.L., Teo, L.S. and Byrne, J.G., 2002. Evaluating interface esthetics. Knowledge and Information Systems, 4(1), pp. 46–79.

Ren Xiaofan., and Xue Chengqi., 2018. Layout evaluation of Camera Connect APP interface elements based on Mido computing. Design, (4), pp. 142–143.

Yin Ting., Li Yang. and Feng Shuangpeng., 2020. Investigation and Analysis of the Influencing Factors of College Students' Choice to Use Music Apps—Taking Changsha College Students as an Example. Jiangsu Business Review, (5), pp. 26–32.

Zhou Lei., Xue Chengqi., Tang Wencheng., Li Jing. and Niu Yafeng., 2013. The beauty evaluation method of interface element layout design. Journal of Computer Aided Design and Graphics, 25(5), pp. 758–766.