Emotional Design System Research for Intangible Cultural Heritage Digitization

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Abstract. This paper investigates emotional design system for digitizing intangible cultural heritage. Firstly, through literature review, research gaps in the related field are identified. Secondly, based on user interviews, subdivided design factors are incorporated into the existing levels of emotional design, and the system is constructed. The weights of these factors are analyzed using methods (AHP) to determine their impact on user experience. Lastly, with a case study of the representative Chinese intangible cultural heritage, 'Longevity Lock', a digital product is developed.

Keywords: interactive design; Intangible cultural heritage; emotional design; analytic hierarchy process (AHP); digital product

1 Introduction

Intangible cultural heritage constitutes a significant component of traditional culture, embodying profound cultural value. Globally, many countries have incorporated cultural heritage preservation into their national science and technology plans, with the internet and digital media technologies playing a crucial role in cultural strategic initiatives [1].

Intangible cultural heritage has gradually shifted from traditional static transmission to a dynamic 'digitalized' mode. Raúl argues that in the future, user feedback and engagement will become crucial indicators for evaluating the effectiveness of traditional cultural dissemination [2]. To achieve better outcomes, an increasing number of relevant products are incorporating emotional design.

Wang Lilan et al. exemplify 'New Dunhuang' series of cultural and creative products to convey and express the intangible aspects of Dunhuang culture, employing emotional design [3]. Liu Weishang et al. explore new strategies in the design of cultural and creative products guided by the emotional needs of Generation Z [4]. Li Shuai et al. combine the characteristics of museum cultural products along with emotional design, summarizing the design patterns for such products [5]. Currently, most related studies qualitatively analyze emotional design at three levels, proposing design strategies, and conducting functional evaluations for intangible cultural heritage products. However, there is a lack of a targeted emotional design system from the perspective of digitizing intangible cultural heritage, as well as a limited analysis of the impact of emotional factors.

2 Emotional Design System

2.1 Emotional Design Factor

The concept of 'emotional design' was proposed by Donald Norman, who divided it into three levels: visceral, behavioral, and reflective level. We will further expand upon the original framework by incorporating subdivided factors. Firstly, we interviewed five users with extensive experience in using intangible cultural heritage digital products. The aim was to understand emotional design factors that influenced their usage experience of such products. Selected interview information (Identity; Products Used; Evaluations) is presented as follows:

1. Student (21 years old); 'Jiang Mu'; Appreciate the artistic beauty of *the Mortise and Tenon* structure through various types of game levels, and exquisite visuals and music.
2. Employee (28 years old); 'Bu Shi'; Clean UI design allows us to understand the development of jade culture, identify different types of jade, and analyze carving techniques.
3. Teacher (42 years old); 'Forbidden City Ceramics'; With over 1,000 exhibited items, we can explore different themed halls, view *porcelains* from a 360-degree perspective.
4. Student (24 years old); 'Forbidden City 365'; Provides comprehensive information on all *palace* areas of the Forbidden City, allowing us to learn about palace architecture, and immerse ourselves in panoramic views.
5. Artisan (51 years old); 'Folding Fan'; An interactive game providing insights into the origin, culture, and production techniques of *folding fans*.

Based on the literature review and interview findings, we expanded emotional design framework from three levels to four levels (Sensory, Comprehension, Interaction, and Dissemination). Additionally, we introduced corresponding factors within each level to construct an emotional design system for 'intangible cultural heritage digitization', as shown in Figure 1:
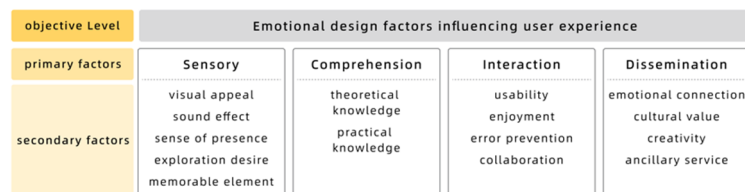

Fig. 1. Emotional design system

Sensory Level: It refers to enhancing user experience from a multisensory perspective [6]. This includes visual appeal (utilizing modern creative presentation methods to provide users with a unique visual experience), sound effect (creating ambiance through background audio and explanatory narration), sense of presence (establishing immersive experiences through scenario settings [7]), exploration desire (gamification design that stimulates users' curiosity, and encourages active and continuous engagement [8]), and memorable element (extracting distinctive traditional symbols of intangible cultural heritage to create a unique cultural charm that leaves a lasting impression on users).

Comprehension Level: It refers to aiding users in developing a systematic understanding, which includes theoretical knowledge (including historical background, aesthetic features, etc.) and practical knowledge (including compositional structure, production processes, etc.).

Interaction Level: It refers to the interactive behaviors involved throughout the user's product usage, including usability (a clean user interface, well-structured functionality, and easy information retrieval), enjoyment (incorporating interactive details to enhance the pleasure of operation), error prevention (providing timely prompts and feedback to assist users in completing tasks), and collaboration (enhancing connections among users).

Dissemination Level: It refers to conveying the spiritual essence of intangible cultural heritage to users through digital products. This includes emotional connection (by offering novel experiences, communication between users and intangible cultural heritage is facilitated, shaping unique emotional memories), cultural value (leveraging digital means to embed intangible cultural heritage within specific humanistic contexts, establishing a scientific narrative system that enables users to develop a comprehensive understanding of its cultural significance [9]), creativity (users can create their own engaging content related to intangible cultural heritage), and ancillary services (introducing more personalized features such as social platforms based on user needs).

2.2 Weight analysis

We employed AHP to calculate the weights of each factor, aiming to examine the extent to which these factors influence the user experience when utilizing intangible cultural heritage digital products. To accomplish this, we conducted a questionnaire survey targeting individuals who have either used such products or expressed an interest in intangible cultural heritage. A total of 54 valid responses were collected.

In previous research, an emotional design system has been developed, consisting of objective level, primary factors, and secondary factors. By analyzing the number of respondents selecting each factor in questionnaire and assigning scores accordingly, a judgment matrix was constructed for weight analysis. Firstly, the weight relationships between primary factors and objective level were calculated:

Table 1. Judgment matrix of primary factors

primary factors	Dissemination	Comprehension	Interaction	Sensory	Wi
Dissemination	1	6	4	4	0.5748
Comprehension	1/6	1	3	2	0.1986
Interaction	1/4	1/3	1	1/2	0.0898
Sensory	1/4	1/2	2	1	0.1368

Table 2. Consistency test for primary factors

Largest eigenvalue	CI	RI	CR	Consistency test results
4.264	0.088	0.890	0.099	Passed

As shown in the table 1 and 2, the weight values of Sensory, Comprehension, Interaction, and Dissemination relative to objective level are 13.679%, 19.858%, 8.980%, and 57.482%, respectively, passing the consistency test. Next, following the same approach, the weight relationships between secondary factors and primary factors were calculated, and the weight relationships between secondary factors and objective level were obtained through calculations, as shown in Table 3.

Table 3. Weight values of secondary factors relative to primary factors and objective level

secondary factors	Wi (primary factors)	Wi (objective level)
visual appeal; sound effect; sense of presence; exploration desire; memorable point	18.979%; 4.860%; 7.856%; 13.682%; 54.623%	2.600%; 0.660%; 1.080%; 1.870%; 7.470%
theoretical knowledge; practical knowledge	12.500%; 87.500%	2.480; 17.380%
usability; enjoyment; error prevention; collaboration	60.709%; 21.995%; 8.648%; 8.648%	5.450%; 1.980%; 0.780%; 0.780%
emotional connection; cultural value; creativity; ancillary services	59.813%; 12.343%; 20.284%; 7.560%	34.380%; 7.090%; 11.660%; 4.350%

Among all primary factors, Dissemination holds the majority of the weight, followed by Comprehension, Sensory, and Interaction, in decreasing order of their impact on user experience. In the analysis of weight relationships between secondary factors and objective level, it is observed that emotional connection, practical knowledge, creativity, memorable point, and cultural value have a significant influence on user experience, while error prevention, collaboration, and sound effect have relatively lower impact.

3 Digital Product

In traditional Chinese folk arts and crafts, Longevity Lock primarily serves spiritual and cultural functions, exhibiting exceptionally high artistic value[10].

Based on emotional design system and relevant information about Longevity Lock, we have developed a digital product called 'Xiao Suo Xian' (Lock Fairy). The design highlights of this product are elucidated through emotional design system as follows:

In Sensory, distinctive cultural symbols of Longevity Lock are extracted and employed for visual design, creating memorable elements. As illustrated in Figure 2, depictions are made of five historical dynasties, two main characters, 'Lock Fairy' and 'Customer,' and the fundamental elements composing Longevity Lock, namely, 'lock discs', 'patterns', 'accessories', and 'collars'. A color palette emphasizing simplicity and elegance has been carefully selected to reflect the enduring cultural of Longevity Lock. Additionally, we have designed icons and a logo that harmonize with overall style, enhancing visual appeal of the product. The homepage features an interactive animated timeline with a sense of spatiality. As users drag the timeline, they experience a perspective transformation in the illustrations, as if they are entering specific historical moments, enhancing their sense of presence and exploration desire.

Fig. 2. Visual design

In Comprehension, as illustrated in Figure 3, users navigate to the knowledge dissemination page, where three-dimensional models of Longevity Lock from different eras are showcased. Users can zoom in, zoom out, and rotate the models to examine their spatial structures. By long-pressing on a model, an outlined image is displayed, providing a clearer presentation of the decorative patterns. Swiping left reveals theoretical knowledge, while swiping right presents practical knowledge associated with Longevity Lock.
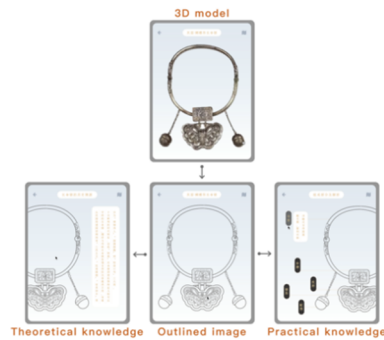

Fig. 3. knowledge dissemination page

In Interaction, delicate design considerations are reflected in certain interaction details. As depicted in Figure 4, the interactive animations of timeline on homepage. Users engage in voice interactions with the main characters, 'Lock Fairy' and 'Customer,' actively exploring desired knowledge. Additionally, the characters' facial expressions add amusement.

Fig. 4. Partial interface display

In Dissemination, select classic segments are extracted from history to construct narrative scenarios, fostering emotional resonance and facilitating a profound understanding of cultural

value of Longevity Lock. Users are encouraged to unleash their imaginations and create unique Longevity Lock models according to their preferences and creativity, which can be utilized for electronic exhibitions, virtual accessory filters, and various other purposes. Establishing an emotional connection is of paramount importance, as digital products fulfill people's emotional needs through knowledge dissemination, scenario creation, interactive communication, and other means.

4 Conclusions

Taking the perspective of 'digitalization of intangible cultural heritage,' we establish an emotional design system and ascertain the impact of each emotional design factor on user experience. Drawing on the example of the 'Longevity Lock,' design practices are conducted, offering new insights for future digitalization endeavors in intangible cultural heritage.

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