

Research on emotional interactive product design under regional cultural background

Guanghui Shen, Yilin Sun*

College of Art ,Zhejiang Shuren University, Hangzhou, 310015

ABSTRACT

In the context of the parallel development of globalization and the revival of local culture, the design of emotional interactive products has gradually moved from a single function orientation to a complex expression of cultural sensitivity and emotional resonance. This paper aims to explore how regional culture profoundly affects the emotional expression and user experience mechanism of interactive products, especially focusing on typical cultural regions such as China, Japan, Europe and the United States. The study selected voice interactive products and public interactive devices as research objects, and adopted case analysis and cross-cultural comparative research methods to systematically analyze the significant differences in language style, feedback methods and cultural symbol presentation of interactive products under different cultural backgrounds from the dimensions of value differences, politeness strategies, and social self. The "culture-emotion matrix" design framework and adjustable multimodal interactive prototype are proposed to effectively improve the emotional adaptability and cultural adaptability of products.

KEYWORDS

Regional culture, Emotional Interaction, Product design, Interactive design

1 Introduction

1.1 Research background

With the continuous advancement of the wave of globalization, information technology and cultural differences have shown unprecedented innovation opportunities and challenges in cross-integration. Under different regional cultural backgrounds, users have significant differences in their emotional experience when using technology products: in Western culture, individual autonomy and efficiency are emphasized; in East Asian culture, collective identity and warm care are preferred; these cultural differences are not only reflected in the language and symbol level, but also have a profound impact on users' emotional needs and experience expectations for interactive products. Voice interaction products and public interactive art installations, as typical media of emotional interaction design, play an important role in daily life and public space respectively. As an important direction of integrating art and technology, emotional interaction design aims to enhance users' immersion and sense of belonging through the integration of multimodal interaction, emotional computing and cultural symbols, and improve product user satisfaction and market competitiveness.

1.2 Overview of current research status at home and abroad

Early research mainly focused on the field of affective computing, exploring emotion recognition and generation algorithms; in recent years, the research focus has gradually shifted to the application of emotional interaction in user experience (UX) and human-computer interaction (HCI), such as Tan et al. (2015) proposed a multimodal interaction strategy based on facial expressions and voice emotions, and Picard (1997) pioneered the emotional computing framework, laying the foundation for subsequent research. The regional cultural dimension is mostly demonstrated by scholars such as Hofstede through quantitative indicators to demonstrate the impact of cultural differences on organizational behavior and design preferences, but the research on cultural adaptability at the level of specific product interaction is still insufficient.

1.3 Research purpose and questions

This study aims to construct a systematic regional cultural emotional interaction design framework, through a multi-case comparison of typical voice interaction systems and public interactive devices, to reveal the similarities and differences of emotional interaction strategies under different cultural backgrounds and their internal mechanisms, and propose corresponding design principles and prototype solutions. Specific research questions include 1. How do regional cultural values affect the emotional expression strategy of voice interaction products? 2. What are the differences in the emotional experience design of public interactive devices under different cultural aesthetic traditions? 3. Based on

regional cultural differences, how to design an adjustable, multimodal cross-cultural emotional interaction system.

1.4 Research methods

Literature research method: Systematically sort out theories such as emotional computing, design psychology, and cultural dimensions to provide theoretical support for case analysis.

Case analysis method: Select representative voice assistant and public device cases, combine official information, third-party evaluations and user comments, and conduct in-depth analysis at the functional and experience levels.

Comparative research method: Based on Hofstede's cultural dimensions and social self theory, conduct cross-cultural comparisons of cases and summarize the differences in emotional interaction design.

Prototype design and evaluation: Combine the analysis results to build a conceptual prototype of voice interaction and public devices, and conduct preliminary verification and optimization of the design effect through small-scale user testing.

2 Theoretical basis and research methods

2.1 Definition and classification of regional culture

"Regional culture" refers to a complex of values, behavioral norms and aesthetic tendencies formed by multiple factors such as history, language, religion, customs and economic level in a certain geographical area. This study mainly focuses on the three major cultural regions of China, Japan, Europe and the United States, and further distinguishes two regional cultural types within China: the South (represented by South China and East China) and the North (represented by North China and Northwest China).

2.2 Cultural Dimensions and Social Self

Hofstede's Cultural Dimensions

The six cultural dimensions proposed by Hofstede provide a quantitative comparative framework for this study, two of which are particularly relevant to emotional interaction:

Individualism vs. Collectivism: In individualistic cultures, individuals value self-realization and privacy more, and interactive products need to meet the needs of efficient and proactive services; while in collectivist cultures, users expect emotional care and a sense of belonging.

Power Distance: In high-power distance cultures, users tend to accept authoritative or hierarchical interactions; in low-power distance cultures, they prefer equal dialogue and autonomous feedback mechanisms.

European and American cultures generally show the characteristics of high individualism and low power distance; East Asian cultures show a trend of coexistence of collectivism and medium-high power distance; there are also subtle differences in the concepts of individuality and authority between the north and south of China.



Figure 1 Hofstede's cultural dimensions

Social Self Theory

The concepts of independent self and interdependent self proposed by Markus and Kitayama (1991) are of great significance for understanding the expression of emotions in different cultures:

Independent self: emphasizes self-boundaries, personal will and independent decision-making, typical of Western culture.

Interdependent self: emphasizes the role and responsibility of the self in the social relationship network, typical of East Asian culture.

Affective computing and design psychology

Affective computing is a discipline that studies how to identify, simulate and respond to human emotions through computers. The main technologies include voice emotion recognition, facial expression analysis, physiological signal monitoring, etc. Design psychology focuses on the generation mechanism of emotions during product use and user experience evaluation methods. Its core principles include:

Context triggering: using multimodal sensors (such as microphones, cameras, touch sensors) to capture user emotional signals in real time. Emotion mapping: mapping the captured data to a predefined emotion model (such as Ekman's seven basic emotions or Russell's two-dimensional emotion disk) to generate a suitable system response strategy.

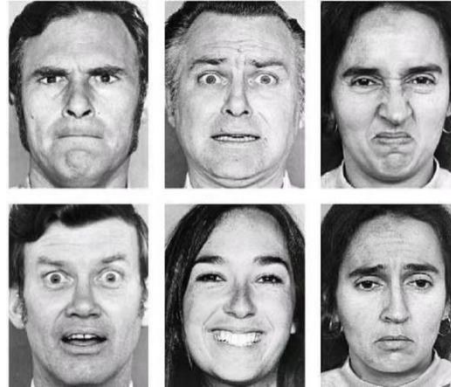


Figure 2 Six basic emotions

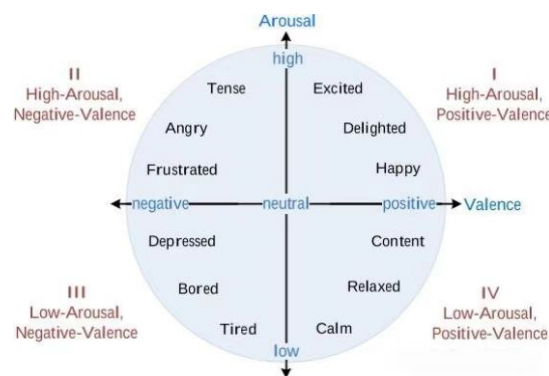


Figure 3 Russell's 2D Mood Disc

Emotional feedback: Enhance users' emotional resonance and satisfaction through various feedback methods such as voice intonation, visual animation, tactile vibration, etc.

3 Analysis of regional culture and emotional expression

Based on the theoretical framework of Chapter 2, the influence mechanism of different regional cultures on emotional expression is analyzed from the macro and micro levels, focusing on the comparison of cultural differences between the East and the West, and exploring how these cultural characteristics affect the user scenarios and interactive characteristics of public interactive devices, providing a profound background for subsequent case analysis.

Values and social relations

Western culture (represented by European and American countries) is deeply influenced by Christian tradition and Renaissance humanism, emphasizing individual rights, independence and rational decision-making. Individuals are regarded as the basic unit of society, social relations are loose, and values tend to be individualistic. In this culture, people often express their emotions and needs in a direct and frank way, and the interaction etiquette is concise and clear, focusing on efficiency and functionality. In contrast, East Asian culture (China, Japan) is rooted in Confucianism, the Middle Way, and religious beliefs (such as Buddhism and Taoism), emphasizing holistic concepts and social harmony. Individuals are regarded as part of a group, maintaining a close relationship with families and organizations, and their values tend to be collectivism. In terms of emotional expression, East Asian culture pays more attention to implicitness, politeness and interpersonal harmony. In communication, emotions are often conveyed in a tactful and indirect way to avoid "disrespect" or "destroying the group atmosphere."

Authority Concept and Communication Style

In Western culture, the power distance is generally low, and roles such as superiors and subordinates, teachers and

students, or doctors and patients tend to interact equally, and the communication style is approachable. There is a strong sense of "equal dialogue" between users and systems, and they tend to call the system name directly or use short commands. In East Asian culture, the power distance is relatively high, and the tradition of respecting the elders and the virtuous makes subordinates maintain a certain polite distance from their superiors. When interacting with the system, users often use more polite language and honorifics, such as adding words such as "please" and "thank you" to the voice assistant to show respect for the elders or superiors.

4 Case Analysis and Design Prototype

Based on the theoretical analysis of regional culture and emotional expression differences in Chapter 3, this chapter selects typical voice interaction systems and public interactive device cases, uses qualitative case study and comparative analysis methods, deeply analyzes the emotional design characteristics and user experience of each case in different cultural contexts, and then refines the design principles and proposes two conceptual prototypes to lay a practical foundation for subsequent discussions and conclusions.

4.1 Case 1: Analysis of Voice Interaction System Based on Regional Culture

Siri (USA, Apple Voice Assistant)

Voice Intonation and Emotional Expression

As the first intelligent voice assistant launched by Apple, Siri uses natural language processing and neural network technology for speech synthesis, making its pronunciation close to that of a real person. Its English tone presents a neutral and humorous style, with a moderate speaking speed and a slightly rising tone at the end of the sentence to show friendliness, but without losing a sense of efficiency. When facing user questions, Siri often gives concise and clear feedback, and occasionally gives humorous answers, reflecting the importance of individuality and humor in Western culture.

4.2 Xiao Ai (China, Xiaomi voice assistant)

Voice affinity and emotional response: Xiao Ai voice assistant is aimed at Chinese users. Its voice synthesis has obvious northern Mandarin characteristics, with a mellow voice and moderate speaking speed. In the interaction, Xiao Ai often uses titles such as "master" and "friend" to narrow the emotional distance with users. In sentences, she often uses modal particles such as "oh" and "ne", reflecting the warmth and implicitness of interpersonal relationships in Eastern culture.

4.3 Gatebox (Japan, virtual two-dimensional companion device)

Anime character anthropomorphic design: Gatebox is positioned as a "home two-dimensional companion" and presents anthropomorphic virtual characters in the form of holographic projection. The character images are mostly derived from Japanese anime culture, and the clothing, words and deeds are full of two-dimensional aesthetics. The voice interaction system can not only conduct daily conversations, but also respond emotionally with personalized character language according to environmental factors such as time and weather, such as "It's very cold today, please keep warm~".

Companionship-style emotional interaction

Gatebox emphasizes the "sense of companionship". The system collects data such as user schedules and emotional feedback, and formulates interactive scripts for virtual characters, allowing users to feel emotional comfort when living alone or working overtime.

Case 2: User feedback and design optimization of emotional public installations

teamLab Borderless (Japan, digital interactive art exhibition)

Integration of natural elements and high technology

teamLab Borderless is known for its "borderless" concept. Through projection technology, sensors and computer vision, it realizes real-time interaction between light and shadow and user behavior. For example, in the "Water Drops in the Forest" exhibition area, visitors' movement triggers the falling of petals and ripples of water, creating a dreamy and vibrant scene.

Atelier des Lumières uses high-resolution projection to dynamically interpret classic Western oil paintings such as Van Gogh and Monet, and immerses the audience in an artistic atmosphere through the coordination of music and light and shadow rhythm. The rhythmic changes of light and sound guide the ups and downs of emotions, such as the soothing piano music when projecting "Starry Sky", which inspires the audience's soft thoughts and romantic feelings.

Rain Room continuously rains through the nozzles above, and the ground sensors detect the position of the human

body and automatically stop spraying when the human body is in the area, allowing the audience to walk in a space where it is "raining" but "not getting wet". The audience has a wonderful experience of being "surrounded by nature" in the quiet sound effects and the echo of water drops.

4.4 Case comparison and innovation

Case comparison

Emotional strategy of voice assistants: Eastern products (Xiao Ai, Gatebox) focus more on "care" and "accompanying", with friendly tone and rich modal particles; Western products (Siri, Alexa) tend to be "efficient" and "independent", with neutral tone and avoid emotional burden.

Aesthetic style of public installations: Japanese installations (teamLab Borderless) highlight the symbiosis between man and nature, triggering emotions with delicate changes; French installations (Atelier des Lumières) emphasize the creation of atmosphere of art and music, shaping emotions through light, shadow and rhythm; British installations (Rain Room) bring a fantasy experience with the confrontation between environment and body perception.

User path and safety and comfort: Western cases pay more attention to user space guidance and comfort optimization, while Japanese cases emphasize detail adjustment and slow-paced aesthetics. Chinese museum interactive installations balance cultural heritage and modern experience, taking into account cultural symbols and user ease of use.

Based on the above analysis, a new "cross-cultural integration" voice assistant prototype is proposed:

Voice style: Using a dual-mode pronunciation engine, it can switch between "efficient mode" and "companion mode"; users can freely adjust the speed, intonation and frequency of modal particles according to the scene (work/leisure).

Localization strategy: Built-in "regional culture library", automatically identify the cultural region of the user, and load the corresponding etiquette expression, joke library and dialect support; for example, northern users can enable "Northeast dialect greetings", and overseas Chinese users can try "Cantonese mode".

Character personality: Set three personality templates for the assistant - "pragmatic", "heartwarming" and "humorous", and users can switch as needed. The emotional feedback mechanism and word strategy between templates are completely different to meet the emotional needs of different cultural levels.

5 Discussion

Based on the case analysis and prototype design results in Chapter 4, this chapter explores the key significance of emotional interaction design from the perspective of regional culture, summarizes the innovative contributions and shortcomings of this study, and proposes subsequent research directions to make a good transition to the conclusion of Chapter 6.

5.1 Summary of Research Conclusions

Through the analysis and comparison of typical voice interaction systems (Siri, Xiao Ai, Gatebox) and public interactive devices (teamLab Borderless, Atelier des Lumières, Rain Room) in different cultural contexts, this study draws the following main conclusions:

Emotional interaction strategies are deeply driven by cultural dimensions

Individualism-collectivism: In individualistic cultures (Europe and the United States), users tend to expect voice assistants to be "efficient and independent" and pursue imperative, function-oriented conversations; in collectivist cultures (China and Japan), users pay more attention to "care and companionship", expecting assistants to show human touch, use polite language and maintain emotional connections.

Power distance: In high power distance cultures (East Asia), users are accustomed to receiving feedback with a sense of hierarchy and politeness; low power distance cultures (the West) prefer an equal and direct conversation style, emphasizing the experience of "I communicate with you on an equal footing".

The integration of cultural symbols enhances emotional resonance

Integrating regional cultural symbols (dialects, traditional totems, natural images) into interaction design can significantly enhance users' cultural identity and emotional resonance. The "Cultural Library" and totem projection device in the prototype of Chapter 4 both received positive feedback from users of different cultural backgrounds in preliminary tests, indicating that the localized use of cultural symbols is an important path for emotional interaction design.

Adjustable multimodal design meets diverse needs

The "efficient/companion" mode switching, three personality templates, and adjustable speech speed and intonation proposed in this study enable the same system to flexibly respond to the emotional preferences of users from different cultures, reflecting the applicability and scalability of multimodal design in cross-cultural scenarios.

Differences in group and individual experience of public devices

In public interactive devices, East Asian users show higher collective emotional participation in group synergy effects (such as the group flower sea changes of teamLab); Western users prefer individual immersive experiences (such as the private fantasy brought by Rain Room), which requires public devices to take into account the balance of group and individual interactions when designing.

5.2 Research innovations and deficiencies

Case comparison framework for cross-category integration

This study, for the first time, incorporates voice interaction systems and public interactive devices into the same culture-emotion research system. Through a unified "culture-emotion matrix" model, it realizes cross-technology category and cross-region comparison and commonality extraction.

"Culture-emotion matrix" driving mechanism

A three-layer model with cultural dimension labels as input, emotional computing model as core, and design strategy as output is extracted, providing designers with a parameterized and reusable guidance method that can automatically adjust emotional intensity, tone style and feedback method according to different cultures.

Adjustable multimodal prototype design scheme

The "efficiency/companionship" mode switching, personality template rotation and cultural symbol dynamic loading are realized in the voice assistant and device prototypes, breaking the limitations of the single style of traditional emotional interaction and verifying the feasibility of adjustable design in cross-cultural scenarios.

6 Conclusion

This study focuses on the theme of "emotional interactive product design under regional cultural background" and focuses on voice interaction systems and public interactive devices in the three major cultural regions of China, Japan, Europe and the United States. The following results are obtained:

Theoretical construction: define the scope and classification of regional culture, integrate Hofstede's cultural dimensions and social self theory, construct a "culture-emotion matrix" fusion mechanism, and sort out the core principles of emotional computing and design psychology.

Cultural difference analysis: based on values, power distance and self-concept, in-depth comparison of the differences between Eastern and Western and Chinese northern and southern cultures in emotional expression, politeness strategies and group collaboration preferences, laying the foundation for case selection and analysis.

7 Discussion

The differences in emotional interaction strategies driven by regional culture and the contextualized value of cultural symbols were summarized, and the design principles of adjustability, multimodality, safety and comfort were extracted; the innovations and shortcomings of this study were reflected, and subsequent research directions were proposed.

References

- [1] Hofstede, G. Culture's Consequences: Comparing Values, Behaviors, Institutions, and Organizations Across Nations 2008,56(2):6--12.
- [2] Markus, H. R., & Kitayama, S. Culture and the Self: Implications for Cognition, Emotion, and Motivation 1991.
- [3] Picard, R. W. Affective Computing 1997.
- [4] Wang Rui Research on the Emotional Design of Digital Regional Cultural Creativity 2021.
- [5] Zhang Lin "Comparative Study on User Satisfaction of Voice Assistants in China and Japan" 2023.