

AR Interaction Design Mode of Multi-user and Multi-character in Theme Parks

Zhou Xin¹, Younghwan Pan²

¹Yango University, College of Design, Fuzhou, China, 350015

²Kookmin University, Interaction Design Lab, Graduate School of Techno Design, Seoul, 02707

Corresponding Author

Younghwan Pan

Kookmin University, Interaction Design
Lab, Graduate School of Techno Design,
Seoul, 02707

Mobile : +82-10-3305-1011

Email : peterpan@kookmin.ac.kr

Received : October 01, 2019

Revised : October 04, 2019

Accepted : October 19, 2019

Objective: This paper expounds the influencing factors of interactive experience combining users and character images, and clarifies the relationship between them, to create the multi-user and multi-character interactive design method and framework of the theme park based on augmented reality technology, which used to improve the satisfaction of the interaction between the user and the character.

Background: In theme parks, the design mode of the user and character interaction based on augmented reality is usually digital display through head-mounted display or handheld device. The disadvantage of the AR platform is that the experience of individual users and conditions are limited, and the lack of multiple users and multiple characters to participate in the interactive process of the real environment.

Method: Through the interactive experience survey and role image scene recognition survey and analysis of specific users of theme parks, combined with the interactive design development needs of theme parks, the analysis and information architecture of multi-user interaction requirements based on the combination of real-world environment and characteristic role image based on AR technology Combing, build multimodal interaction design structure and dynamic behavior patterns.

Results: Interaction Design model of multi-user and multi-character based on AR technology interaction, helps meet user expectations and interaction needs. It creates a solution for multi-user and multi-character interaction in the theme park, so that users don't have to worry about any equipment, thus creating the walk-in game experience, and the expertise of multimodal is also more accessible for users to high engage in the theme park with character interaction.

Conclusion: AR based multi-user and multi-character interaction design model can give full play to the effects of AR technology and provide a general solution to the limitations of theme parks' character interaction design that can emulate in specific interaction scenarios. And complements the academic research on multi-user and multi-role in theme parks in theory filed.

Application: In this situation, one thing is predictable: the interactive design model developed in this study can apply to user and character interaction in various theme parks, which is helpful for brand identification and character communication of different theme parks.

Keywords: Augmented Reality (AR), Multi-user, Multi-character, Interaction design

Copyright©2019 by Ergonomics Society of Korea. All right reserved.

© This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/3.0/>), which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

1. Introduction

The opening of Disneyland in Los Angeles in 1955 marks the birth of modern theme

parks. With time passing, theme parks have formed a large scale industry and spread all over the world. According to the report released by the International Association of Amusement Parks and Attractions (IAAPA) in January 2017: In 2015, despite the global economic downturn, the theme park industry as a whole still maintained a sustained and stable growth of more than 7% due to the impact of new technologies and the expanding global theme park market (IAAPA, 2017). According to the latest statistics released by the international tourism organization (UNWTO), the number of foreign users arriving in 2017 increased by 6.7%, the highest since 2010, reaching 1.322 billion (World Tourism Organization, 2017). According to the latest data of the 2017 global theme park survey report jointly released by TEA and AECOM, the world's top 10 theme park groups received 476 million visitors in 2017 (Aecom and TEA, 2017).

The latest relevant literature studies mainly focus on the direct economic value of theme parks, while there are few academic studies on the relationship between the brand value of theme parks, such as character, user and technology interaction design, Yaqian said (2019). Occasionally seen the theme park model academic research, like a paper described a method for simulating IoT-based theme parks. Pawel et al. (2018) presented methodology integrates several models: Tourists behavior model, tourist attractions model, theme park model and simulation model. And Multi-User content like demonstrated the multi-modal tracking, the free movement, as well as the multi-user features enabled natural interaction with other users and the environment, and thereby engendered a comfortable social experience (Wienrich et al., 2018).

But actually, the high and new technology industry has a strong influence in a theme park, and the theme park usually invests 18% to 25% of its revenues in park facilities and content. An important change in recent years is the increasing proportion of high-tech investment, such as increasing the application of AR and VR, human-computer interaction, to improve comfort and so on (Horwath Consulting China Office, 2019). In the past two years, more and more theme parks have experimented with immersive technology, and Universal and Disney have acquired several AR/VR patents. Bizjournals USA reported that Universal's new patent -- "systems and methods for generating augmented and virtual reality images" -- shows that it is considering bringing immersive technology to its theme parks, as well as exploring the integration of theme parks and VR/AR technologies (Cindy Barth, 2017). The same patent (annulus Motion Simulation Amusement Park Attraction), which was approved by the group with an annulus effect, relates to VR/AR technology (Wu Yuhua, 2018).

In the past 60 years, Disney park has always paid attention to the perfect combination of movie IP and artificial dream, and committed to using science and technology to optimize the design and experience of amusement facilities, make the park into a complete fairy tale dream, create a comprehensive immersive experience for users. Disneyland is recognized as a model of modern theme parks, and the exploitation and application of IP commercial value have become an essential means for Disney to expand its influence continuously (Huayi brothers institute, 2017). Disney CEO Bob Iger has said that AR technology is more suitable for use in Disney theme parks than VR technology. In April 2017, Disney released a new patent based on AR, which was submitted by Mouse House and called "AR control for user interaction in virtual worlds" (Zoey, 2017). On August 11, 2018, Disney released another patent for its "Multisensory Augmented Reality" (The United States patent trademark, 2018) system. Similar to the interactive version created to commemorate video, when visitors stand in front of the green screen, augmented reality makes it look like they're in an amusement park environment. Meanwhile, Disney Research Hub has posted a short video on its official YouTube channel and introduced a way to automatically cover human bodies with digital 'waterproof suits' based on standard RGB images. AR Costumes: Automatically Augmenting Watertight Costumes from a single RGB Image, Disney will soon be able to use augmented reality to change clothing for visitors, providing breakthroughs in entertainment as well as new and unique experiences (Disney Research Hub, 2018).

Theme park generally let visitors enter the three-dimensional space through thematic appearance, storyline, composition and frame, scene atmosphere, equipment packaging design, scientific and technological means. The combination of a full range of adventure, experience exploration, memories and other exciting series of experience, improves the sense of reality and mystery of

experience (Improvement of Scorpio, 2019). However, due to the limitations of technical conditions, there are usually the following shortcomings in the interaction process of AR technology-based users with the character of the theme park (Figure 1):

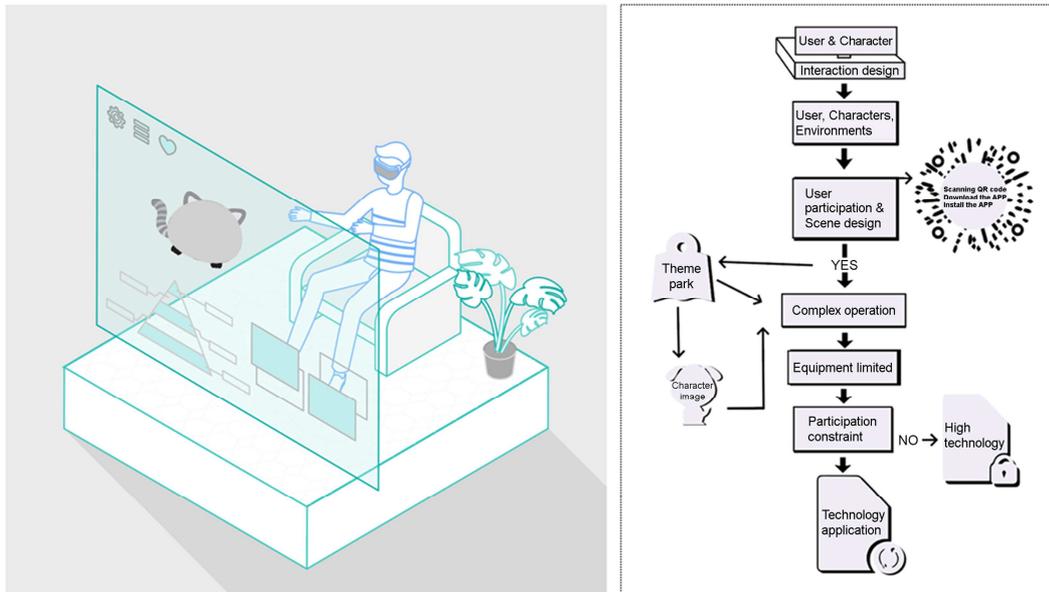


Figure 1. Task flow chart

(1) Operation: The current situation of AR is that it is impossible to create a seamless original AR experience (Vr gyro, 2018). The AR experience project of theme park requires thousands of users to download the corresponding APP, follow the instructions, and understand the concepts and rules to have a perfect experience.

(2) Vision: The interaction between users and characters base on augmented reality in most theme parks, is still limited to mobile phones. Mobile AR mainly depends on the mobile phone to provide precision technology to help people build visual illusion. By mobile phone camera, content and interaction of fun is in the equipment present world, but the user is in the real world outside the device.

(3) Input: In recent years, cell phone AR technology tried to eliminate glasses to achieve immersively, and improve the method of using facial, hand gestures, such as language, and rely on voice command to interact with the content, such as opening a mouth or raising your eyebrows to control character in the augmented reality (Pursuer, 2019). But the introduction of other experience still needs to rely on existing original interaction. Such interaction is limited by the available input on the market interaction.

(4) Contact: Due to the limited technical level of AR at present, some special effects based on AR experience cannot be triggered exactly at any specified time of each project or theme point, and cannot provide the same experience effect for many users at the same time. Most visitors can't fully experience the immersive character interactions of AR with sound, light, landscape, display, movement and other special effects in the theme park, but only watch or participate in the part of AR.

(5) Mode: At present, AR interaction between users and IP images in theme parks usually limited to a single user and single character model, which cannot meet the actual needs of multi-user and multi-character interaction, and users' visual experience

and emotional experience are limited.

Because of the above constraints, the following theme and visitor classification, experiments, and experimental analysis are conducted to explore the multi-user and multi-character interaction design of AR technology in theme parks.

2. Method

Under the guidance of "German Industry 4.0" Christoph (2016) and "Made in China 2025" Zhi (2015), AR is an essential high-tech application in various industries. It is not only the development trend of the industry, but also an important issue in the development of theme parks to application of the interactive mode of multi-user and multi-character and the novel and unique experience for users. For example, Shenzhen happy valley plans to continuously add VR, AR, 4K panoramic and holographic entertainment experience products based on 5G transmission in the future, to improve the playability, experience, and diversity of products in the park (Orange tourism, 2019). Disney chief executive Robert Iger also spoke at the New York summit and praised the augmented reality attraction at Animal Kingdom, said that there is more opportunities for augmented reality application (Gabrielle Russon, 2019).

2.1 Theme and visitor classification

The purpose of applying AR technology in theme parks is to help users better achieve interactive experience with these characters and meet the immersive experience needs of different users. Therefore, the primary problem is how to classify the nature of various users' needs in different theme parks.

According to the type of tourism experience, theme parks can divide into five categories, which are: situation simulation, amusement, sightseeing, theme experience (Wikipedia, 2019). In particular, the theme park appeals to the two elements of "scene reproduction" and "film", and combines the IP image of the theme to create an escape from the real world, allow users to enter the topic of the scene, and users can enjoy the space of play projects, have "immersive experience".

IAAPA data sources: the half of the visitors to the theme park are family members, and the other half of them are friends traveling together. The user group consists of many age groups by statistical analysis (IAAPA, 2017). On the one hand, young users need to be more particular, more exciting, more in-depth interaction experience. On the other hand, visitors need to provide more relaxed entertainment family function, and these changing needs require theme parks to incorporate design into the environment, content and the fuzzy interface boundaries, continually using the latest technology to meet the user interaction and character under different environmental challenges.

2.2 Experiment

This experiment mainly selects large theme parks, which have absolute investment scale, cover an area and a certain proportion of entertainment facilities, and the city-level theme parks which have particular popularity in local areas and meet the definition standards of theme parks. The experiment does not include characteristic towns, pure landscape parks, commercial scenic spots, single aquariums, and botanical gardens.

The questionnaire survey based on the "user, character, scene" 3 measurement in the theme park. On the basis of interaction with the theme park character in technology innovation, character, innovation, environment innovation, process innovation, subject interaction experience to visitors satisfaction respectively what effect for content to visitors to investigate. According to the KANO questionnaire from Kano et al. (2011) and Likert scale, the above five indicators are selected from the small influence to the more

considerable influence (from 1 to 5) Carifio and Perla (2007).

It includes the necessary information of users, innovative interactive mode of theme parks, and empirical research on the relationship between users and characters. The research on the relationship between users and characters is based on the needs of this paper, and based on the analysis of existing studies to make the hypothesis, such as the demand degree of multiple users and multiple characters. Interactive experience satisfaction obtained through the measurement of the existing research is contained in the research content of this paper. A total of 200 questionnaires were issued, and 196 responses received, among which 194 were valid with an effective rate of 98.98%. Sample distribution: 78 males and 118 females, 95% of whom are aged between 15 and 45 years old, have experience in theme parks, and 50% of them have experience in happy valley, Disney and other large theme parks. People with a bachelor's degree or above account for 92%, and with an income of over 3500 yuan account for 77%. The distribution of survey samples is reasonable.

3. Results

3.1 Analysis the questionnaire

According to the survey statistics: In terms of the main reasons for going to theme parks, 48.98% of the visitors wanted to Experience the advanced technology of the theme park, while 42.86% wanted to experience the advanced technology of the theme park, 33.67% to appreciate the characters in the theme park.

(1) As for the overall satisfaction of theme scene arrangement, 71% of users think the theme is satisfactory, 64% think the interest is adequate, 55% think the comfort is satisfying, but only 48% thought the technology is competent, and 47% thought the interactivity is satisfactory.

(2) Regarding the overall satisfaction of the theme scene layout, 71% of the visitors considered the theme to be satisfactory, 64% of the visitors thought the interest to be adequate, and 55% of the visitors felt comfort, but only 48% Visitors believe that science and technology are satisfactory, and 47% of visitors believe that the interaction is satisfying.

(3) In terms of satisfaction with immersive experiences in the theme parks, 61 percent of the users thought video effects are satisfactory, 74 percent thought audio effects are satisfactory, 45 percent think tactile effects are satisfactory, but more than 65 percent thought smell and taste effects are unsatisfactory. It can be seen that multi-user and multi-character interaction can can strengthen in taste, smell, and touch.

(4) For theme park character individual satisfaction, 74% of visitors think that the character's appearance was satisfactory, 76% of visitors believe the characters' anthropomorphic was competent, 63% of visitors think that character's story is satisfying, but only 48% of visitors believe the characters' speech recognition is pleasing, 45% of visitors believe the characters' dynamic interaction effect was satisfactory.

(5) To experience the satisfaction of different themes, more than 60% of the visitors thought during the process of fusion of subject and the environment, experience immersive, lighting, music, atmosphere, such as layout, are satisfactory, but more than 50% of users thought interactions with the subject character image experience, high-tech means, such as virtual reality, augmented reality, holographic projection technology... Aspects are mediocre or unsatisfactory.

(6) In the character interaction in the theme park, more than 50% of visitors thought that there can be multi-user participation in innovation, high-tech interactive innovation, scene design, and atmosphere innovation, 55.1% of visitors thought theme park

need multi-character interactive innovation, and diversified technical innovation (Figure 2).

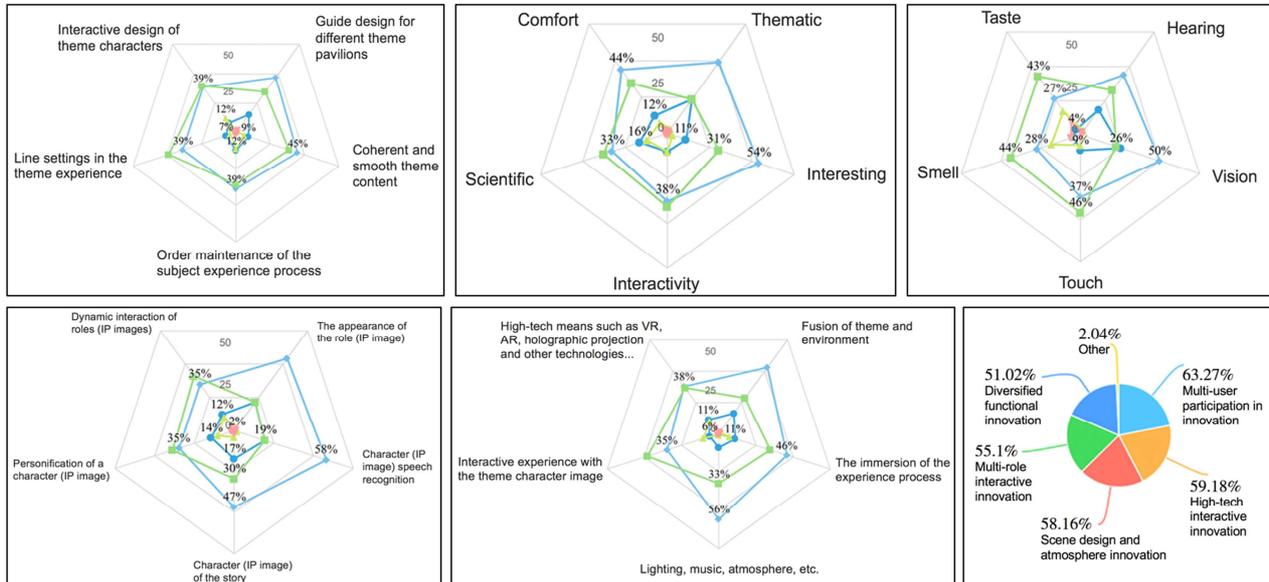


Figure 2. Data analysis diagram

Finally, when asked what would you say if the latest augmented reality technology enabled immersive, multi-user, multi-character interaction without relying on the device? 68.37% express curiosity and will try, 29.59% curious but wait until someone else tries.

3.2 Interactive demand analysis

In the book 《About face 3.0》, author Alan et al. (2007) writes that one of the most important goals of designers is to make the presentation model as close as possible to the user's mental model. Therefore, through the user research results, research character interaction, technical relationship, psychological experience, etc., to differentiate the different needs of users, and understand the needs of users at different levels, then find the entry point to improve user satisfaction. The influencing factors divided into five types: mandatory factors, non-differential factors, reverse factors, attractive factors, and expected factors, it's very important that we should learn more about the target user's thought "how to interact with the theme park character". and understand the deep psychological needs of users for determining the interaction object (Bartikowski and Llosa, 2003).

Can be seen from the Kano model (Figure 3). The expectations of users factors (one-dimensional) focused on the more users to participate in innovation, scene design, and atmosphere, high-tech interactive innovation, more interactive innovation, diversified functions. When providing the demand, customer satisfaction will improve, when this requirement is not available, the user satisfaction reduced. The charm factor that can be improved is the addition of touch, smell, and taste. If this demand is not provided, user satisfaction will not reduce, but when this demand provides, user satisfaction will be highly improved. The reverse factors are a complex operation, equipment limitation and participation limitation. Therefore, how to achieve the goal of multi-user and multi-character interaction by combining effective technical means has become the key to research.

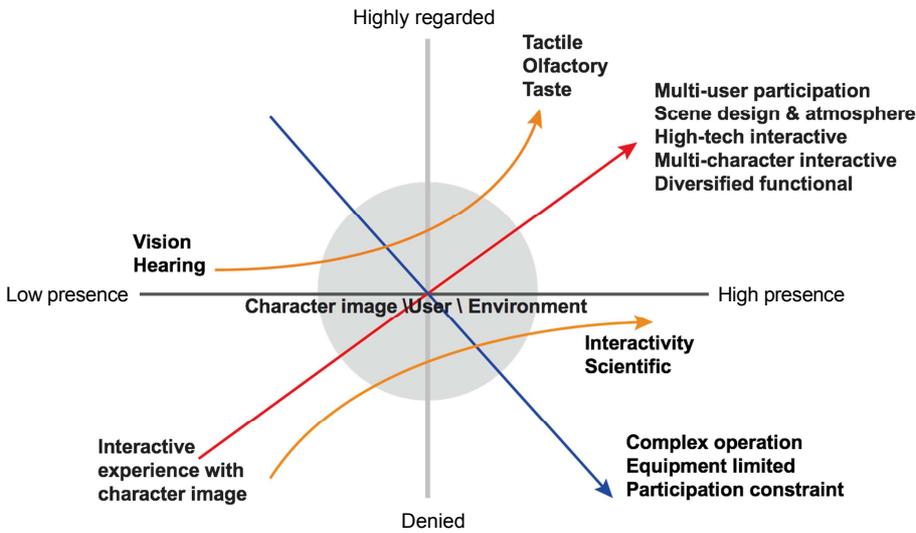


Figure 3. KANO model of multi-user and multi-character interaction requirements

3.3 Character interaction design mode

3.3.1 Information architecture

Through the analysis and research on the classification of users and the interaction with theme parks and other preliminary data, found that the single user and single character interaction design mode cannot meet the deep interaction needs of most users. Therefore, the paper propose the design concept of multi-user and multi-character interaction mode between users and characters in theme parks, establish the possibility of multi-user and multi-character interaction through AR+ technology and construct the possible paths of different interactive objects. Analogies with interaction design behavior focus on four key elements: character, purpose, means, and contexts. On how to proceed with the user and character interaction model design, the author sums up the four-in-one interactive system (Figure 4). Four are: User category, Environmental theme, Technology, Virtual objects, the following also spawned 17 branches respectively. The author uses the model to guide the theme park multi-user and multi-character interactive system design work. The key elements are summarized.

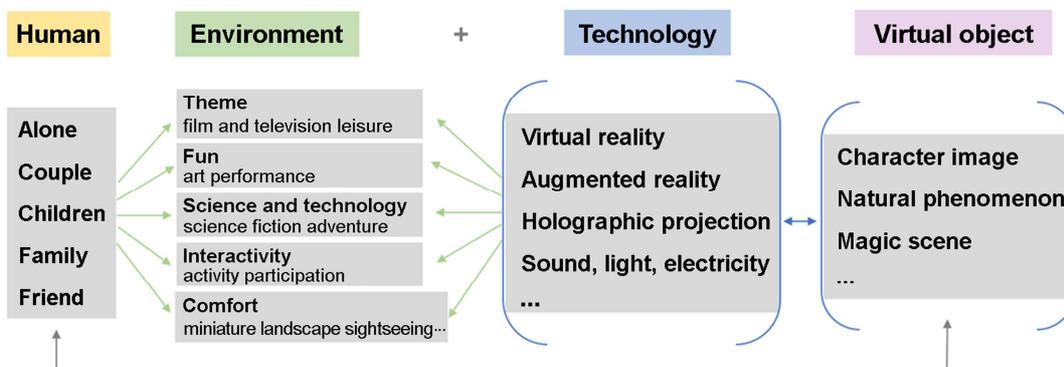


Figure 4. Four-in-one Interactive diagram

3.3.2 Multimodal interaction structure

The mode concept of interaction design comes from Christopher et al. (1997), best known for his 1977 book "A Pattern Language", a perennial seller four decades after publication which laid a foundation for the proposed mode of interaction design. Interaction design mode mainly includes structure and element organization, dynamic behavior changes.

Usually using science and technology in the modern theme parks includes virtual images, sound, and light, laser special effects, such as digital technology improve the experience of the sense of reality and mysteriousness. Users often still need to use high-tech equipment to interactions with the character. Due to the complex operations, equipment conditions, restricted participation, interactive position fixed action and interaction, interactive mode of a single, etc., lead to operation is not very realistic and interactive immersive is not enough. Most visitors have high expectations on how to use interactive technology to enhance touch, smell, taste, etc., and achieve the natural interaction of multiple users and characters.

Disney also filed a patent for an AR projector system "Magic Bench" in 2017, which allows visitors to experience AR without wearing any device on their body (Ifanr, 2017). In reality, the demand of users is to remove equipment and participation restrictions, so that multiple users can be immersed in an environment at the same time, and can conduct face-to-face communication and discussion with multiple characters. Disney wants to complete the interaction with characters based on common goals, and their interactive operation and results can be seen in real time. Therefore, to present how to meet the interaction requirements of multi-user and multi-character with the latest AR technology, a multimodal interaction model is designed (Figure 5).

Based on AR technology, multimodal interaction integrates the multimodal interaction modes of vision, hearing, touch, smell and even taste, and integrates the multisensory interaction between user and character into the design, so as to build a synesthetic experience of multi-user and multi-character interaction. "Synaesthesia" is a necessary requirement for a pleasant experience.

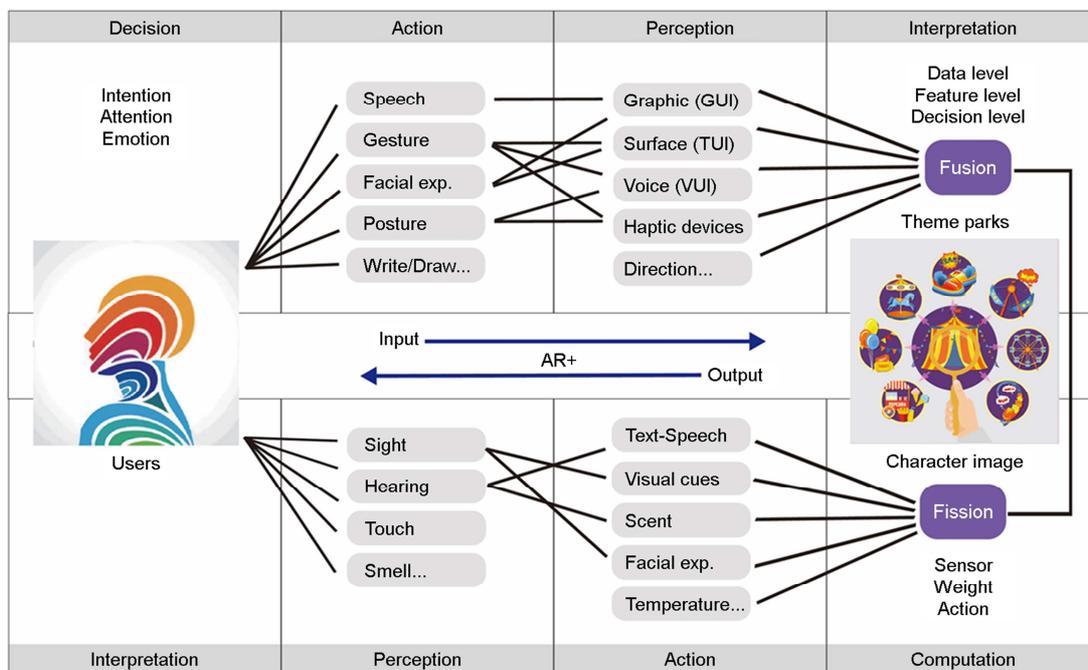


Figure 5. Multimodal: User-Character Interaction Model

Multi-sensory resonance is called "synesthesia" from Zhongshu (1994). The multi-mode natural interaction of multi-user and multi-character mainly divided into four modules, which are multi-mode interactive information calculation, information perception, fusion and processing, and information interpretation.

Then, when using these multi-modal content, it is necessary according to the theme park five scenarios AR technology requires (film and television leisure, art performance, science fiction adventure, activity participation, miniature landscape sightseeing), combined with the enhanced instrument to detect the environment. When multi-user enter the corresponding environment, they become the controller of the theme environment, and trigger multi-character interaction behavior through computer feedback, using the audio device to enable the user to hear the sound of the character coming, and using the image device to let the user see the character entering the space. Using depth sensing technology and computers to calculate the user's location and number of people in real time etc., and infer the user's eye Angle, multi-role can also interact directly with multi-user through voice or touch, and the multi-character can directly interact with multi-user through voice or touch. The user does not need to carry any equipment, so that the user can directly interact with the characters, as to augmenting the world that the user is already in.

4 Discussion

Cognitive psychology believes that behavior is the essence of the user's cognitive model driven (Solso et al., 2008). So in multi-user and multi-character interaction design process, requires a combination of the previous analysis users such as perception, memory, thinking, comprehensive study of the cognitive content. Perfect the system function structure design, and the surface of user interface design, from the perspective of functional architecture conforms to the user's cognitive, achieve cognition and interaction model on the system representation of consistency. To explore the immersive interaction design of multi-user and multi-character in AR in the future, and establish a task flow model of the more immersive visual field and natural gesture interaction.

The model presents the basic interaction factors of users, characters, and the environment. Through multi-character participation and scene design innovation, the immersive natural interaction environment is created to achieve the boundary between fuzzy content and interface, and based on AR technology combined with the latest technology to achieve the function innovation, breaking operation, equipment, and the participant's limitation, to implementation multi-user and multi-character technology application implementation (Figure 6). The following three points should be mainly considered in the application details of augmented reality technology:

- (1) Complete character presentation. We need to ensure that the theme persona appears from the best perspective in the environment. Integrating multi-mode information perception technology into the technology of AR scene actualization, starting from the values and behavior patterns of users, making the information more effectively communicated and effectively transformed into the behaviors and decisions of users, and developing more exciting interactive content and more thoughtful technical services.
- (2) Appropriate interactive distance. Create a multi-user and multi-character participation environment for users without equipment through technical conditions, enabling users to walk-in and immerse themselves in the natural interactive environment. In the AR walk-in immersive experience, it is necessary to ensure that users can enter the augmented reality interaction scene after two or three steps, and set the nearest and furthest interaction boundaries between users and character images. Then combines whimsical scenes, architecture, colors, character images and other visual elements, users become an important part of the interactive design.
- (3) The layout of the scene elements is logical. We need to consider the relationship between the character and other elements in the real scene, and should design the logical scenario in combination with the design ideas of visual stability and rapid reset of users in the movement. Virtual objects of augmented reality are used to intuitively display the actions that users need to

cooperate with, reduce the selection of interfering factors, and guide users to make cooperative actions so as to successfully conduct multi-user and multi-character interaction. And give feedback to users' actions in time to prevent mistakes. Users' misoperation can be cancelled.

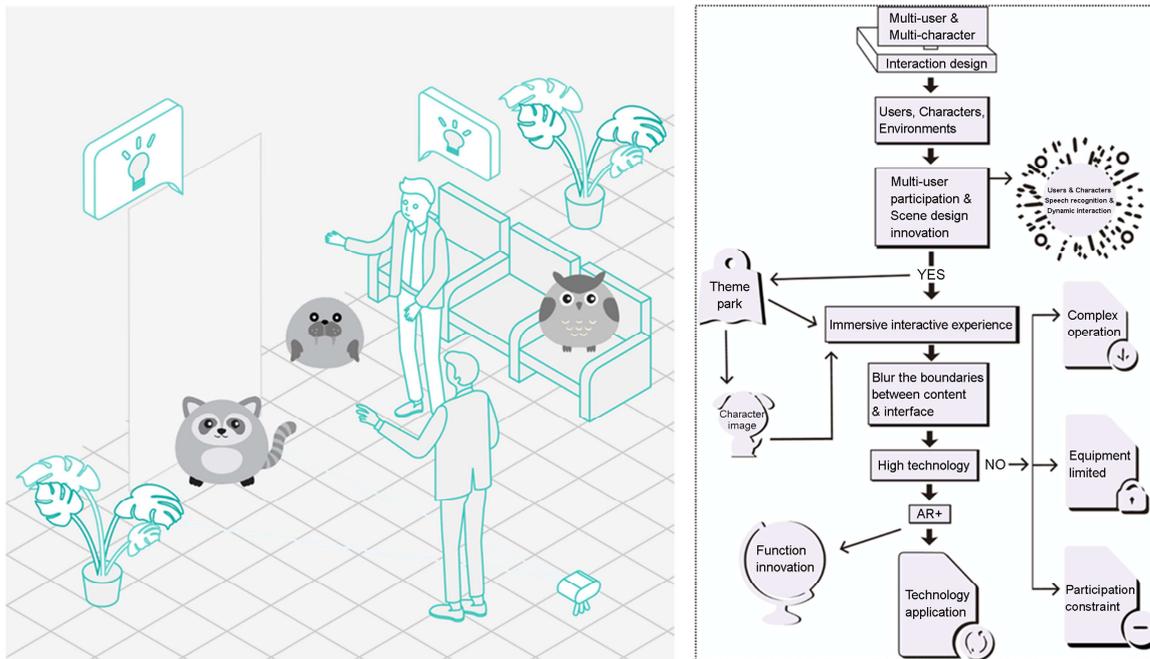


Figure 6. Mission flow diagram

In the view of gestalt psychologists, the real natural perceptual experience is the dynamic whole of the organization, while the combination of sensory elements is artificial accumulation. Because the whole is not simply the sum or addition of the parts, the whole is not determined by the parts, but by the internal structure and nature of the whole (Kurt, 2010). Therefore, in the process of constructing multi-user and multi-role interaction design, attention should be paid to the combination of tourists' natural perception experience to reflect the core value of character interaction in the theme park. As Walt Disney said, "you can dream and build the most beautiful places in the world, but make Disneyland the happiest place in the world." I hope it will bring you all happy memories, no matter when. This quote was later regarded as a classic quote by Disney, which is the standard definition of the image of Disney characters. Therefore, in the multi-user and multi-role interaction based on augmented reality technology, certain rules should be followed to enable tourists to organize their perceptual experience materials into a meaningful whole and build a high-quality theme park brand experience.

5. Conclusion

Through the extensive research theme park, users questionnaire analysis, technical conditions, limitations and the analysis of the character communication, brand development, according to the problems found in theme park character interaction and opportunities, on the basis of making full use of existing resources, the author create multimodal interaction design patterns based on AR technology. By improving the system functional architecture design, user interface design and the functional architecture perspective consistent with the user's perception, achieve the consistency of cognitive and interactive models. Establish task flow

model of more immersive visual field and natural gesture interaction by solving the problems of the immersive interaction design of multi-user and multi-character in AR in the future. Multi-user and multi-character theme park interaction mode are helpful to meet users' expectations and interactive needs. Multi-mode experience is also easier for users to deeply participate in the interaction of theme park character images.

With the development of science and technology, more and more interactive ways have realized, and the bare single amusement equipment has become less and less competitive. The competition of theme parks is not only a competition of the uniqueness and attractiveness of character images, but also an innovative means of realization promoted by science and technology. Those who use the advantages of technology, innovative design around the theme character to create surprises for visitors, are more popular in the near-stage. As the soul element of the theme park, the character has gradually recognized by the market. And technology as an essential means to connect with the users and characters, bring the natural feeling, immersion, and experience to users in the theme park. It becomes a primary means for the theme park to be rich in content and attractive. Therefore, AR based multi-user and multi-character interaction design mode can give full play to the effects of AR technology, aiming at the limitations on the interaction design of theme park characters, the design criteria can be understood from the psychological and behavioral nature of users, and a general solution can be provided for imitating specific interaction applicable scenarios.

From an academic point of view, the systematic review and analysis of the multi-user and multi-character interaction needs is complementary to the academic research on the interaction status between the original theme park users and characters. The interaction design model not only involves the multi-modal interaction design structure and element organization, but also pays attention to the dynamic behavior and changes of the cognitive users, so as to effectively provide the expectation factors and the charm factors for the users, which has certain academic logic and methodological significance. For the development and construction of today's theme parks, it also has considerable theoretical support value, so that the theme park can satisfy user development of interactive demand change, make the theme park more attractive, and advantageous to the theme park brand recognition and characters transmission.

Acknowledgement

This paper has been conducted with the support of the "Design Engineering Postgraduate Schools" program, a R&D project initiated by the Ministry of Trade, Industry and Energy of the Republic of Korea (N0001436).

References

- Aecom, TEA (Themed Entertainment Association). 2017 global theme parks and museums survey index, 2017.
- Bartikowski, B. and Llosa, S., Identifying Satisfiers, Dissatisfiers, Criticals and Neutrals in Customer Satisfaction, Euromed - Ecole de Management, Marseille, Working Paper n° 05-2003, 2003.
- Carifio, J. and Perla, R.J., "Ten Common Misunderstandings, Misconceptions, Persistent Myths and Urban Legends about Likert Scales and Likert Response Formats and their Antidotes" *Journal of Social Sciences*, 3(3), 106-116, 2007.
- Christopher, A., Sara, I., Murray, S., Max, J., Ingrid, F.K. and Shlomo, A., *A Pattern Language: Towns, Buildings, Construction*, Oxford University Press. (pp. 789-1020), 1977.
- Christoph, J.B., *The concept Industry 4.0*, *The Concept Industry 4.0*, (pp. 27-50), 2016.

Cindy Barth, *Orlando Business Journal*, <https://www.bizjournals.com/orlando/news/2017/06/29/7-things-to-know-today-and-where-millennials-are.html> (retrieved Jun 29, 2017).

Cooper, A., Reimann, R. and Cronin, D., *About Face 3: The Essentials of Interaction Design*, (pp. 27-39), 2007.

Disney Research Hub, *AR Costumes: Automatically Augmenting Watertight Costumes from a single RGB Image*, <https://www.youtube.com/watch?v=p2Lj2SclkvA> (retrieved October 31, 2018).

Gabrielle Russon, *Disney won't push VR at its theme parks, Robert Iger says*, <https://www.orlandosentinel.com/business/tourism/os-cfb-bob-iger-vr-parks-20190514-f4wbb54gefehxicn7552hqq37m-story.html> (retrieved May 14, 2019).

Horwath Consulting China Office, *What is the difference between France and China's theme park market?*, <https://www.traveldaily.cn/article/128391> (retrieved April 4, 2019).

Huayi brothers institute, *from Disney, merlin, IMG and lotte understand the logic behind the theme park*, the <https://www.iyiyou.com/p/38605.html> (retrieved February 2, 2017).

Ifanr, *Disney and new gameplay, this bench magic*, <https://www.ifanr.com/880642> (retrieved July 27, 2017).

Improvement of Scorpio, theme park planning and design experience, <https://www.douban.com/group/topic/136417386/> (retrieved March 21, 2019).

International Association of Amusement Parks and Attractions. *IAAPA Global Theme and Amusement Park Outlook 2016-2020*, 2017.

Kano, N., Nobuhiku, S., Fumio, T. and Shinichi, T., "Attractive quality and must-be quality" *Journal of the Japanese Society for Quality Control* (in Japanese), 14(2), 39-48, 2011.

Kurt, K., *Principles of gestalt psychology*, Peking University press, (pp. 205-229), 2010.

Orange tourism, Happy valley in hand AR black technology makes acme new experience, <https://m.smartoct.com/informations/detail? Id = 262> (retrieved May 21, 2019).

Pawel, P., Stanislaw, D., Radoslaw, B., Miroslaw, P. and Małgorzata, P., *Multi-domain model for simulating smart IoT-based theme parks*, SPIE-the International Society for Optical Engineering, 2018.

Pursuer, immersion design: the trend of the next 10 years, <https://zhuanlan.zhihu.com/p/66072455> (retrieved May 16, 2019).

Solso, R.L., Maclin, M.K. and Maclin, O.H., *Cognitive psychology*, Shanghai people's press, (pp. 112-126), 2008.

The United States patent trademark, <http://pdfaiw.uspto.gov/.aiw? Docid=20180315243> (retrieved March 15, 2018).

Vr gyro, how to correct the VR/AR into theme parks, <https://vr.ofweek.com/news/2018-06/ART-815014-8470-30240093.html> (retrieved June 13, 2018).

Wienrich, C., Schindler, K., Dollinger, N., Kock, S. and Traupe, O., Social Presence and Cooperation in Large-Scale Multi-User Virtual Reality - The Relevance of Social Interdependence for Location-Based Environments, 2018 IEEE Conference on.: 207-214 Mar 22, 2018.

Wikipedia, Theme park, <https://zh.wikipedia.org/wiki/%E4%B8%BB%E9%A1%8C%E5%85%AC%E5%9C%92> (retrieved May 1, 2019).

World Tourism Organization, <http://www2.unwto.org/> (retrieved October 16, 2017).

Wu Yuhua, Applicable to theme parks, Disney and universal have obtained a number of AR/VR patents, <https://yivian.com/news/52354.html> (retrieved October 7, 2018).

Yaqian, H., Value evaluation of theme parks based on TBCI-take Shanghai Disneyland as an example, Shandong university, 2019.

Zhi, Z., The main direction of intelligent manufacturing "made in China 2025". China mechanical engineering, (pp. 273-284), 2015.

Zhongshu, Q., A Collection of Seven Compositions, Shanghai Ancient Books Press, (pp. 89-120), 1994.

Zoey, Disney today filed a patent for AR projection to open up AR theme park play mode, <https://36kr.com/p/5069817> (retrieved April 7, 2017).

Author listings

Zhou Xin: 124789269g@gmail.com

Highest degree: Master, Visual Communication Design, Art College, Guangxi Normal University

Position title: Lecturer, College of Design, Yango University

Areas of interest: Interaction Design, Augmented Reality, Visual Communication Design

Younghwan Pan: peterpan@kookmin.ac.kr

Highest degree: PhD, Department of Industrial Engineering, KAIST

Position title: Professor, Graduate School of Techno Design, Kookmin University

Areas of interest: User Experience Strategy, Service Design, Interaction Design