Research on the Application of Augmented Reality Technology in the Transformation and Development of Cultural and Creative Industries

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Abstract

INTRODUCTION: In this paper, China Hainan "Li" national woven culture is used as an example, the status quo and problems of cultural creative in-dustry in Hainan are analyzed, and the new trend of the development of Hainan cultural creative industry is further clarified.
OBJECTIVES: The integration of AR technology and cultural creative industry is the main research object.
METHODS: This study integrates technology into culture, introduces AR technology to integrate the development of Hainan cultural and creative industrial development, and propose the transformation strategy of cultural industries to integrate scientific and technological innovation. The application examples of enhanced reality technology are introduced. summarized the four technical characteristics and advantages of AR technology with virtual fusion, real-time interaction, two-way mode and multi-intensity.
RESULTS: One preliminary result was Augmented Reality is a promising media to learn, promote and protect Hainan national brocade culture.
CONCLUSION: It concludes generally Augmented Reality promoteslearning about, and builds back better Hainan's cultural and creative industry.

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1. Introduction

Broadly, cultural and creative industry is a strategic emerging industry cluster in China. Deeply digging regional characteristic culture, tracing historical origin, and perfecting the continuity and promotion of culture are important ways to protect culture. The extraction, application, and innovative development of cultural elements are effective measures for cultural inheritance. For example, The protection, development and inheritance of the brocade culture of the Li nationality in Hainan (Fig. 1 & Fig. 2).

Cultural and creative industry takes cultural content and creative results as an end (core value) for that industry. On the other hand, it takes creation and innovation as the means, it creates and enhances cultural resources with the help of high-tech and others, for example, Augmented Reality (AR)(See Section 3) of this work. It provides enjoyable and culturally relevant flow of interactive experience designed for consuming public. In order for that industry to thrive, it should have the characteristics of strong creativity, multi-industry integration, less resource consumption, less environmental pollution, high risk, high added value, sustainable development, cultural value dissemination and others. See also Xiaojun. (2018)[1].

Fig. 1. Traditional Li Nationality Brocade form and works in Hainan, China

Fig. 2. The Creative Forms and Works of Li Jin Culture in China

Hainan province is the largest island in China, inflexed constantly by waves of immigrants of foreign nationalities since the Neolithicage. According to Zhenqing(2013), Hainan was mainly the ancestors of Li, Lingao people, the central plains people, immigrants from southeast and southwest of China and other regions.[2] Ling (2012) stated that after a long historical evolution and present in Marine culture, li and Miao folk custom, the Red Culture, Nanyang culture, the island culture is given priority to the characteristics of regional culture. [3] In a new era of high-quality development in China, Hainan is an important pivot of China's One Belt and One Road strategy, a free trade port, an island of educational innovation and an island of digital wisdom in China's national strategy. Refer also to Koleski (2017) [4]. It not only has a unique geographical advantage, but also has a special political status. At present, although Hainan has abundant cultural resources, the development of cultural and creative industries is relatively low, a complete industrial chain has not been formed, the integration of technology is insufficient, and the added value of products is low. The integration of modern technology represented by AR technology into Hainan's cultural and creative industries will help Hainan to transform into a digital and intelligent island, which has contemporary research significance.

This article puts forward the point of view and attempt to integrate cutting-edge technology into Hainan's cultural industry, which can make up for the lack of attractiveness and single model of Hainan's cultural and creative industry. This point of view and attempt can well promote Hainan's regional culture and enhance consumer experience.

2. Present Situation and Existing

Problems of Hainan Cultural and Creative Industry

For nearly five years, China has issued "Hainan's tourism industry development planning" that includes (a) the construction of Hainan international tourism consumption center of the implementation of the plan, (b) the State Council on overall plan issued by the China (Hainan) free trade area of the notice, (c) the propulsion of Hainan province cultural creativity and design services, (d) related industrial convergence development plan and (e) other series of policies and measures. Although people's understanding of the development of Hainan's cultural and creative industries is deepening, various policies are issued one by one, and the construction process is gradually accelerated, the development of Hainan's cultural and creative industries.

Hainan is still plagued with various problems and contradictions under the new situation of building an international free trade zone, mainly manifested as follows: (a) the contradiction between the high goal of cultural and creative industry construction and the outdated concept of industrial planning under the background of international free trade zone. The contradiction between the lack of high-quality cultural creativity and management personnel and the demand of enterprise development, (b) the contradiction between the demand of regional cultural propaganda and the imperfection of cultural output system, (c) the contradiction between low quality of cultural and creative products and projects and the public's demand for high-quality cultural and creative products and projects, (d) the contradiction between the demand of the times of cultural integration of science and technology and the insufficiency of cultural excavation and scientific and technological means, and finally(e) the positive development of cultural and creative industry and the contradiction between intellectual property protection and development lag. The basic reason lies in the low level of cultural and technological development in Hainan, and many regional cultural resources have not been effectively developed and utilized.

An effective strategy to promote the transformation and upgrading of Hainan's cultural and creative industries is to actively explore, associating the deep integration of Hainan's cultural industry and science and technology. The application of AR (See Section 3) is in line with the development of the times and the needs of Hainan to build an international free trade zone. It is helpful for the export of Hainan regional culture, so that citizens and tourists can understand and learn the connotation of Hainan regional culture in an all-round and multi-functional way. At the same time, the application of AR is also conducive to upgrading the types of cultural and creative products and projects to meet the consumer needs of the public and improve the added value of products. Secondly, the application of AR can also promote the cultivation of cultural and creative industry talents, build a digital environment, and enhance the soft power and international influence of Hainan culture.

3. Introduction of Augmented Reality and its application advantages

3.1 Augmented Reality

Augmented Reality (an interactive and immersive flow of live experience, varying from Reality to Virtual Reality (VR)) is to superimpose ecologically (Gibson, 1977), computer-generated enhanced information (or affordance) into the real environment seen by the observer organically, in real time and dynamically[5]. According to Huishu(2019),when the observer moves in the real environment, the enhanced information also changes accordingly[6] .The enhanced information is just as if it exists in the real environment（Fig. 3）. In other words, AR as in this work provides one basic structure for learning about Hainan Cultural and Creative Industries through play.

Fig. 3. Application of AR in Tourism-Scenic AR Pray[10]

Traditional VR is dedicated to fully immersing users in the computer-generated virtual world, which requires accurate modelling of the environment and a huge amount of work(Fig. 4). AR to eliminate the modelling for the environment, the core idea is: in the real world fusion computer-generated virtual objects, and make the virtual objects and reality of the world as an organic whole, enhances the user the perception and understanding of the real world, and when the camera motion, virtual objects can be synchronous tracking real environment, real-time registration (Fig. 5).The advantages and characteristics of AR enable it to be applied in many fields such as tourism, entertainment, education, games, museums, clothing, art, exhibition sales, medicine, cultural and creative gifts, and others. See also current works of Asadzadeh (2021)[7]. The application of AR in cultural and creative industries can improve the upgrading of manufacturing industry, speed up commercial publicity and marketing (Fig. 6), save time and cost and gain real experience.

Fig. 4.VR Experience Form and Scene Construction[11]

The development of IAT consists of three phases which enable Kinect node and calibration at phase 1, design particle and motion at phase 2, and creating effects on particle visual at phase 3. It is very important to make sure each of the phases should be completed successfully before other phases could proceed. The development stage can be used as a guideline and identified as a strategic plan for developing the project.

At phase 1, the interactive sensor which is Kinect was used and set. The software used in this project called Touch designer. Before this software could be used with the Kinect, it has to be enabled and test. Kinect sensors need to be tested to make sure that their sensor functioning well (refer Fig. 1). During the testing, the calibration needs to be performed. The calibration of the Kinect sensor needs to be tested with the human body part such as the hand, neck, shoulder, and leg. To merge the sensor with the visual, the setup needs to be performed. The setup involves by activating the Kinect calibration with the value of x, y, and z. When the calibration value appears and is verified successfully, the next phases could be started.
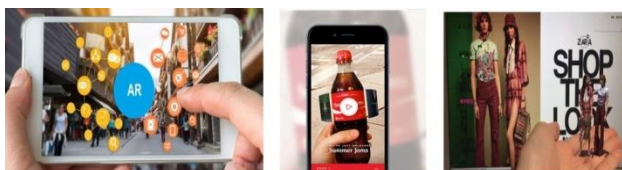

Fig. 5.AR Application Examples

Fig. 6.AR Marketing Example

Augmented Reality fast becoming all areas of our lives. Worth mention are ARKit API tool and ARCore.

(a) In June 2017 Apple released the ARKit API tool for developers working on VR and AR applications. The ARKit Tool is designed to accurately map the surrounding using SLAM (Simultaneous Localization and Mapping). Moreover, no external equipment is required to create AR experiences.

- Painting Apps: VR studio (such as Normal) has brought together the HTC VR Kit and iOS beta powered iPad in its new AR app. It has built an augmented reality

painting tool that replicates the action of the HTC Vive wearer on the iPad screen.

- Strategy Games: During the Worldwide Developers Conference (WWDC) the audience were given a visual treat. Wingnut AR, a game development studio, showcased a virtual battlefield that could be easily developed into a strategy game.
- Tape Measure: Measurement Cloud, built by Smart Picture 3D, can be used as a measuring tape. Smartphone with this app can do the job.
- Vehicle Purchases: People who are too busy to accompany their children on their first bike or car purchase can use an ARKit built application to preview the vehicle.

Education: Krutosh, an iOS developer, has designed an iPhone application that can bring virtual planets and stars in the living room. This app demonstrates the potential of augmented reality in the field of education.

(b) ARCore also known as Google Play Services for AR, is a software development kit developed by Google that allows for augmented reality applications to be built.

- ARCore uses three key technologies to integrate virtual content with the real world as seen through smart phone's camera.
- Six degrees of freedom allows smart phone to understand and track its position relative to the world.
- Environmental understanding allows smart phone to detect the size and location of flat horizontal surfaces like the ground or a coffee table.
- Light estimation allows smart phone to estimate the environment's current lighting conditions.
- ARCore has been integrated into a multitude of devices.

Turning to Billinghurst (2018), they conducted a systematic study on the usability of augmented reality and reviewed the most influential AR user research from 2005 to 2014, research shows that the application of AR technology has broad prospects[8].

Their work suggests, AR applications have huge development potential and technological dependence in 9 areas such as collaboration, interaction, industry, education, tourism, medical care, games, and navigation. Early research on AR was mainly based on Head-Mounted Displays (HMD), but in the past few years, the use of handheld AR devices has increased rapidly, and more advanced hardware and sensors have emerged. These new wearables and mobile devices have created new research directions, which may affect the categories and methods used in AR user research. Through the development in recent years, especially the arrival of the 5G era in 2019, the superiority of the real-time interaction and perception functions of augmented reality has become more prominent, which has provided great help for our life improvement and technological development.

3.2 Advantages and characteristics of the application of Augmented Reality in

Hainan's cultural entrepreneurship industry

Virtual integration and real reproduction. AR used real world virtual environment seamlessly as a whole, letting users feel true integration of harmony. Not only users can feel things in the objective world through VR system, and but also break through the space, time and other constraints (Huishu, 2019)[6].

AR integrates Hainan's cultural resources potentially in the following manners. On the one hand, it can quickly identify Hainan's local cultural resources, save users' time and shorten the space distance. On the other hand,it enables through the virtual screen AR glasses, present the dynamic scene, all kinds of cultural and historical past through video, images reappear with rich digital media display of historical context, such as cultural connotation, the greatest degree of let users experience the rich cultural resources in Hainan and the historical background, to deepen the user understanding of Hainan, for the publicity and promotion of history and culture in Hainan play a positive role. Fig. 7 demonstrated AR restoration scene of the ancient Chinese Old Summer Palace.

Fig. 7.AR Historic Building Restoration[12]

Real-time interaction, immersive experience. AR is to supplement the real scene, but not completely replace the real scene. Through such a virtual fusion to enhance the user's understanding and feelings of the real environment, so as to achieve the "enhanced" effect. Users can interact directly with virtual objects or virtual environments through interactive devices, which enhances users' perception of the environment. In the development of Hainan cultural resources using Augmented Reality, real-time interaction between users and devices can not only close the psychological distance between users and Hainan, but also allow users to interact according to their own needs. View the details and contents of interest from all angles, especially for some fragile cultural heritage such as Chinese porcelain, or the display of precious brocade from Hainan, as shown in Fig. 8. Immersive interactive experience can not only enrich the content, expand the form, but also get instant feedback through the user's interactive data, and understand the possible problems of the product or project through data analysis, so as to adjust and upgrade in time.

Fig. 8.AR Porcelain Display

Two-way mode to enhance effectiveness. Enhanced display technology can be divided into positive and negative two-way enhancement mode. The positive enhancement mode is to supplement and expand the real environment with virtual information to enrich its experience environment and effect. The negative enhancement mode is to adopt the "disappear hidden" mode of material desalination or hiding the real environment in harmony with the real environment. Reduce the perception of the real environment and reduce the impact of disharmony factors on the display effect. Two-way enhancement mode of AR plays a positive role in the development of Hainan cultural resources. For example, the unique Nanyang architectural style of Haikou Arcade old street has become a typical representative of Haikou city style (Fig.9). The two-way enhancement mode of augmented reality can show the prosperity of and reduce the influence of surrounding modern buildings on its historical and cultural atmosphere.

Fig. 7. Theoriginal scene of the old Arcade Street in Haikou and the AR light show effect

Multi-sense enhancement, the reality is not discernible. Augmented Reality not only gives people close to real experience in vision, but also can achieve realistic effect in sound, touch and smell. For example, Hainan traditional dance and musical instrument performance is a popular form of cultural entertainment. However, these performances require special auxiliary equipment, manpower cooperation, limited by the venue, personnel, atmosphere and other factors, most of the audience cannot experience the performance brought joy and comfort. By the advantages and characteristics of Augmented Reality, the development of AR bamboo pole dance, AR octave and other experience projects can not only show consumers the perfect performance of dance and instrumental music, but also meet the comprehensive needs of users in a limited space to obtain visual, auditory, tactile and other senses. As shown in Fig. 10, if the Hainan bamboo pole dance performance is combined with the AR stage scene, virtual bamboo poles and auxiliary personnel are used to reduce venues, tools, and

personnel intervention factors, which will bring people a new viewing experience. By using the organic combination of AR and Hainan's characteristic cultural resources, we should explore cultural and creative products and cultural experience projects, select representative cultural heritage content innovation and development, promote the deep integration of Hainan's cultural and creative industry and science and technology. Finally form Hainan's cultural and creative industry development path with outstanding characteristics such as creative product development and sales, cultural project development and experience, non-posthumous cultural heritage, and science and technology promotion.

Fig. 8. Hainan Bamboo Pole Dance Show and AR Stage Scene[13]

By summarizing the research on AR technical characteristics and applications, this article basically divides AR applications into three categories, namely product display, scene display, and interactive experience. Specific examples, technical characteristics and application advantages of the three categories are shown in the table below.

Table 1. Features and Advantages of AR Applications

No.	Application scenario	Technical characteristics	Application advantage	
1	**Products Show** Such as cultural relics display, cultural and creative works display, &marketing product display.	Element integration, &information interaction,	a.	The object is highly protective and has a good protective effect on rare objects and vulnerable objects.
			b.	The object has good display ability, which can integrate various elements such as static and dynamic, and express the characteristics and attributes of the object in 360 degrees in all directions.
			c.	Break through regional and temporal constraints
2	**Scenario Shows** Such as stage performance, teaching and	Element integration, human-computer interaction,	a.	Expansion of the form of expression.
			b.	The richness of content.

No.	Application scenario	Technical characteristics	Application advantage
	teaching.	Three-dimensional registration, real-time tracking.	c. Representation of breakthroughs in geography and time and space. d. Breakthrough in display range. e. Reduce cost control.
3	**Interactive experience** Such as game experience, special training, collaboration, &navigation.	Fusion of VR elements, Human-computer interaction, three-dimensional registration, Real-time tracking, natural interaction.	a. Enrich the experience of the experiencer. b. Extend the experience space, increase the difficulty and breadth of the experience. c. In high-risk environments, experiencers have high safety. d. Break through geographical and temporal constraints. e. Reusable, resource sharing.

4. Research on Cultural and Creative Development of Hainan Based on Augmented Reality

Although Hainan's rich cultural resources provide fertile soil for the development of cultural and creative industries, some cultural resources with local characteristics have not been well developed and utilized. For example, Li nationality traditional textile dyeing embroidery technique (Li Jin technology) is a kind of textile skill used by Li nationality women in Hainan Province, China. It integrates spinning, dyeing and embroidery, and makes clothes and daily necessities with cotton, hemp and other fibres. Li Jin technology, which has existed for more than 3000 years, is the oldest cotton textile dyeing and embroidery technology in China and even in the world and is known as the "living fossil" in the textile history of China ". However, with the development of science and technology, because of the single way of inheriting Li Jin's skills (and traditions) and the limited object of inheritance, Li Jin's skills are facing a crisis of loss of transmission. UNESCO put it on the list of intangible cultural heritage in urgent need of preservation in 2009.

4.1 Li brocade display and protection using AR techniques

Through fusion of AR, and Li brocade development, user in scenic spots, museums, shopping malls, airports, and lounge can quickly through the display device and even open hole, all-round, multi-dimensional, integrated understanding of the history of the Li brocade and weaving process, pattern characteristic, at the same time, appreciate the show can get related audio, can in-depth understanding of the cultural connotation of li brocade.AR will greatly save the display cost of brocade, expand the scope and content of display, and strengthen the effect and influence of display. In recent years, the relevant departments at all levels in China have made great progress in the protection of li brocade culture, but Li brocade's "spinning, dyeing, weaving, embroidery" skills protection results are not balanced, the crisis of technology loss has not been eliminated. At present, the number of people who master the techniques of "dyeing" and "embroidery" is relatively small. The techniques of "dyeing" and "embroidery" are reproduced by virtual technology, and the corresponding resource database is constructed by using digital technology, which can better protect the inheritance of the techniques and attract more people to learn and study the brocade of Li nationality.

4.2 Using AR to create brocade interactive experience

Users can not only watch and understand Li brocade culture through AR, but also participate in product design and process production through virtual simulation, experience the production process of products, and make their own unique products. Users can feel the charm of traditional skills. Finally, everyone can experience the production of products, everyone is a product designer, everyone studies non-legacy culture, everyone buys non-legacy products characteristic tourism model. Through the interactive experience of AR, we can enhance consumers' cognition and experience of Hainan's traditional brocade skills, and promote the propaganda and promotion of Hainan's national and folk culture.

4.3 AR was used to repair and restore Li brocade

Li brocade includes traditional Li costumes, dragon quilts and modern innovative products of Li brocade, among which traditional Li costumes and dragon quilts are generally made with a long history. Most of the existing dragons' quilts were made in the Ming and Qing dynasties. Because the dragons' quilts were cotton textiles and the humid climate in Hainan, after hundreds of years of baptism, some dragons' quilts were damaged in varying degrees. The use of AR to repair and copy the damaged dragon quilts and the traditional costumes of Li nationality is the rescue protection of Li nationality brocade. By respecting the original form and cultural connotation of quilt and traditional dress, use AR technology to virtual display the broken pattern, organization structure, style shape and color attribute of dragon quilt, combine dynamic and interactive technology, reproduce Li nationality textile treasures to users in many directions. Besides, AR can also be used to repair with Hainan ancient buildings, unearthed cultural relics, underwater porcelain and so on, which is helpful to

the protection of Li nationality's national characteristics and the spread of Hainan regional culture.

4.4 Using AR to develop Li brocade's innovative products

Integrating Li brocade culture into our life is the best protection and inheritance. Using AR to explore the development of clothing products and cultural innovation products based on Li brocade culture is the development trend of the times and industries. Taking clothing innovation as an example, this paper uses Augmented Reality to design Li brocade clothing innovation, and deeply excavates the connotation of Li brocade culture. Assemble the current fashion trend, design elements through real-time digital models, animation and video images for information transmission and processing, forming interactive two-dimensional or three-dimensional dynamic image images superimposed in clothing, make static images dynamic, transfer more information, and bring users a new experience. Besides, it has great prospect and significance to use the AR to develop the virtual fitting, custom-made clothing and online and offline sales of Li traditional clothing and innovative clothing.

In this study, AR is applied in the traditional textile skills of Li nationality, which is conducive to the cultural extension and connotation output of Li nationality brocade, so that more people can understand Hainan's excellent intangible cultural heritage. It is conducive to promoting the development and display of brocade related products, expanding its cultural and creative product structure and display channels, and realizing the transformation of related industries and economic growth. The reproduction of traditional technological weaving process through virtual technology plays a positive role in promoting the protection and inheritance of brocade weaving.

5. Conclusion

In the development of cultural and creative elements, augmented reality is a very important technical tool. At present, the development foundation of Hainan cultural industry is weak, and there are still some outstanding contradictions under the background of international free trade port construction. Relying on modern science and technology to help Hainan's cultural and creative industries to achieve leapfrog development is the realistic need for Hainan to develop the digital economy, and it is also the specific requirement for Hainan to build a major national strategy of "intelligent Hainan" in Hainan. This paper elaborates the path of the integration of Hainan's cultural and creative industries and Augmented Reality and making full use of the characteristics and advantages of Augmented Reality to deeply integrate with Hainan's rich cultural resources, promote the promotion of Hainan's characteristic culture, and enhance the soft power and international influence of Hainan's culture. Expand the digital research and development of cultural creative products to promote

digital cultural consumption. It will help transform and upgrade Hainan's cultural and creative industries and provide theoretical and practical basis for realizing the goal of regional intelligent development in Hainan.

References

[1] Xiaojun, X. , Donghai, Zh. , et al. (2018) On International Experience and Development Strategy of Cultural and Creative Industry in Hainan International Tourism Island. China National Expo (01):37-41.

[2] Zhenqing, Hongshuang,Zh. (2013) Sustainable development strategy of Hainan Li nationality cultural eco-tourism. Economic perspective (1), (10):49-50.

[3] Ling,Q. (2012)Accelerating the Development of Cultural and Creative Industries and Promoting the Construction of Hainan International Tourism Island. China Economic Review, (28):40-42.

[4] Koleski, K., (2017) The 13th Five-Year Plan. U.S. China Economic and Security Review Commission. Staff Research Report.
https://www.uscc.gov/sites/default/files/Research/The%201 3th%20FiveYear%20Plan_Final_2.14.17_Updated%20(002),
last accessed 2017/02/14.

[5] Gibson, J.J. (1977) The Theory of Affordances (pp. 67–82). In R. Shaw & J. Bransford (eds.). Perceiving, Acting, and Knowing: Toward an Ecological Psychology. Hillsdale, NJ: Lawrence Erlbaum.

[6] Huishu,Zh,. Hongchao,P,.Wanming,L. (2019) Research on the prediction and application of augmented reality technology in cultural and creative industry. Design, 32(09):41-43.

[7] Asadzadeh,A.TahaSamad-Soltani&PeymanRezaei-Hachesu. (2021) Applications of Virtual and Augmented Reality in Infectious Disease Epidemics with a Focus on the COVID-19 Outbreak. Informatics in Medicine Unlock (24)100579.

[8] Billinghurst,A,D., Linderman, R.W. & Swan II, J.E. (2018) A Systematic Review of 10 Years of Augmented Reality Usability Studies: 2005 to 2014. Frontiers in Robotics & AI, 5 (37).

[9] Guowei,Sh., Yongtian,W., Liuyue, et al. (2009) Application of Augmented Reality Technology in Cultural Heritage Digital Protection. Journal of System Simulation,(04):2090-2094.

[10] Tencent video ： "Meet the Cheng Huangge" AR pray for travel，
https://v.qq.com/x/page/v32194mzyev.html,
last accessed 2021/01/07.

[11] Snowball: Holoride creates a new car entertainment virtual reality experience,
https://xueqiu.com/u/7748174714,
last accessed 2019/10/16.

[12] Tencent video ： AR reproduces the Great Water Method of Old Summer Palace，
https://v.qq.com/x/page/m08973sz0zd.html，
last accessed 2019/07/10.

[13] Unreal Engine: 2021 CCTV Spring Festival Gala AR Packaging,
https://www.sohu.com/picture/450877170,
last accessed 2021/02/15.