Hindawi

*Retraction*

# Retracted: Design of Chinese Opera Cultural Platform Based on Digital Twins and Research on International Cultural Communication Strategies

## Mobile Information Systems

*Mobile Information Systems* has retracted the article titled "Design of Chinese Opera Cultural Platform Based on Digital Twins and Research on International Cultural Communication Strategies" [1] due to concerns that the peer review process has been compromised.

Following an investigation conducted by the Hindawi Research Integrity team [2], significant concerns were identified with the peer reviewers assigned to this article; the investigation has concluded that the peer review process was compromised. We therefore can no longer trust the peer review process, and the article is being retracted with the agreement of the Chief Editor.

## References

[1] L. Ma, "Design of Chinese Opera Cultural Platform Based on Digital Twins and Research on International Cultural Communication Strategies," *Mobile Information Systems*, vol. 2022, Article ID 6996377, 12 pages, 2022.

[2] https://www.hindawi.com/post/advancing-research-integrity-collaboratively-and-vigour/.

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*Research Article*

# Design of Chinese Opera Cultural Platform Based on Digital Twins and Research on International Cultural Communication Strategies

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As an important part of a country's diplomatic strategy, international cultural communication is increasingly valued by countries. But the traditional way of communication has been unable to keep up with the pace of the times. Digital twin technology can realize virtual reality, which can be applied to the design and dissemination of opera cultural platforms. The influence of a country's culture not only depends on whether its content has unique charm but also depends on whether it has advanced means of communication and strong communication ability. The purpose of this paper is to study how to design an opera cultural platform based on digital twins. This paper proposes a three-dimensional transformation algorithm based on digital twin, which can play a good role in the design of the opera culture platform. The experimental results in this paper are shown in Table 1. In 2016, the economic benefits brought by international cultural communication to China were 35.889 billion yuan. It increased by 3.735 billion yuan year-on-year, with a growth rate of 10.4%. By 2019, the economic benefits brought by international cultural communication to China were 50.730 billion yuan, with an increase of 49.66% over the previous year and a growth rate of 9.7%. It can be seen that, through continuous external communication, this aspect shows the cultural strength of the country and obtains an excellent international reputation and social benefits. On the other hand, it reaped considerable economic benefits. Therefore, it is very necessary to study the strategies of international cultural communication.

## 1. Introduction

In recent years, with the improvement of China's comprehensive national strength and international influence, Chinese culture has received more and more attention, and the scope of dissemination has also expanded. But, at the same time, the spread of Chinese culture in the world is also facing various challenges. In the context of globalization, how to enhance the soft power of Chinese culture and expand the influence of Chinese culture is the focus of today's Chinese culture development strategy. In today's world, cultural competition and dissemination have become a trend. That is to say, cultural communication can promote the exchange and integration of different cultures and promote the formation and development of multiculturalism.

In the previous forms of dissemination of opera culture, there has been no great innovation in dissemination methods except for traditional information push channels such as websites and WeChat platforms. The public's understanding of opera performances is also obtained through specific information links related to opera. The singleness and limitation of the dissemination method limit the dissemination of opera culture and also hinder the consumption of mass entertainment. The way of dissemination of opera culture should change with the changes of the times, in line with the public's aesthetic orientation in terms of storyline and performance form, and be close to life. It is necessary to focus on the current situation of the development of opera, from the perspective of thinking and cognition, and focus on the way of opera transmission. Under the premise of using public media art, it is necessary to create interactive works that allow the public to participate in interaction and emotional exchange.

The innovations of this paper are (1) it introduces the related theoretical knowledge of digital twin technology,

opera culture, and international cultural dissemination. It also proposes a three-dimensional transformation algorithm based on the digital twin and analyzes how the digital twin plays a role in the design of the opera culture platform. (2) It conducts research on traditional cultural communication methods as well as cultural communication methods based on digital twins. It is learned through experiments that cultural dissemination based on digital twins is more conducive to arousing people's interest and promoting international cultural exchanges.

## 2. Related Work

The development of the "global village" promotes cultural exchange, dissemination, and integration between countries. Chinese culture is extensive and profound, and it is inseparable from the continuous exchanges between China and other countries and national cultures. This is an important driving force for China's cultural development. With the increasing influence of cultural communication in recent years, people have begun to pay attention to the strategy of international communication. Cui C found that the protection and dissemination of China's intangible cultural heritage had developed from a single industry activity to a social effort involving a wide range of fields. How to raise the awareness of the younger generation has become an important issue for the protection and dissemination of intangible cultural heritage. The scholar recognized the importance of cultural communication, but did not explain how it carried out cultural communication [1]. Hoguane et al. aimed to demonstrate the use of media through installations in media digital art. Especially among the young class, it can lead to reflection and awareness of the risks and problems caused by the media digital art. The scholar believed that digital media art is at risk. But what is the risk, he did not explain [2]. Barrile et al. found that bronzes, due to their excellent manufacture, represent important sculptural masterpieces in the world. He introduced the realization of the 3D model of the two sculptures. The results he achieved demonstrate the effectiveness of 3D printing to create digital products and reproductions. But the scholar did not describe the specific experimental process [3]. Zhang et al. found that in order to realize smart manufacturing, the country has formulated new strategies, and the number of new factories in developed and developing countries is increasing. He proposed a digital twin-based approach for rapid personalized design of insulating glass production lines. The scholar did not explain why he chose digital twin technology [4]. Zhuang et al. believed that digital twin technology is the core and key technology for realizing cyber-physical systems. Product digital twin is one of the applications of digital twin technology in the product development process. He conducted research on the future development trends of product digital twins. The scholar mentioned that he wanted to conduct research on digital twins, but did not describe the process or results of the research [5]. The purpose of Kuznetsova et al.s discovery scientific work was to use production-based digital twin modeling to assess the level of information security of automated enterprise systems. He worked on solving the problem of building digital twins of enterprise automation systems. He proposed the use of digital twin technology to evaluate information from automated systems. However, the scholar did not draw corresponding conclusions [6].

## 3. 3D Transformation Algorithm Based on Digital Twin

*3.1. The Dissemination of Opera Culture.* The cross-cultural dissemination of Chinese opera in the first half of the 20th century showed a very good trend. Among them, there are many outstanding Chinese scholars and performers of Chinese opera who are patriotic and proficient in Chinese opera [7]. It is also because during this period, the continuous wars, although they brought endless suffering to the Chinese people, also opened the door to China. This gives the West the opportunity to come to China, and it also facilitates the opportunity for the Chinese to go abroad. Chinese opera has finally been able to show its unique charm on the Western stage. Opera generally refers to Chinese opera. Chinese opera is mainly composed of three different art forms: folk song and dance, rap, and burlesque. It originated from primitive singing and dancing and is a comprehensive stage art style with a long history. During this period, the cross-cultural communication of Chinese opera was mainly based on text communication [8]. Opera culture is shown in Figure 1:

As shown in Figure 1, later, the cross-cultural dissemination of Chinese opera was mainly performed by large groups in the form of cross-border performance visits. With the founding of New China, the government was able to plan transnational visit routes while coordinating actors. This makes the cross-cultural dissemination of opera in addition to the dissemination of Chinese culture, adding more diplomatic color [9]. Chinese opera, Greek tragedy and comedy, and Indian Sanskrit opera are known as the three ancient drama cultures in the world. After a long period of development and evolution, it has gradually formed the Baihuayuan of Chinese Opera with the five major opera genres as "Peking Opera, Yue Opera, Huangmei Opera, Pingju Opera, and Henan Opera." As a part of the new China's diplomatic construction, Chinese opera has played an ice-breaking role in eliminating estrangement in the process of establishing or restoring diplomatic relations with many countries. The cross-cultural dissemination of Chinese opera has experienced a process from single type to diversity.

*3.2. Feasibility of Combining Digital Twin with Chinese Opera Cultural Platform.* In recent years, with the development of information technology, a new round of industrial transformation and technological revolution has emerged. It promotes intelligent manufacturing to become an inevitable trend in the development of the manufacturing industry [10]. In the practice of intelligent manufacturing, digital twin has been widely concerned as the best solution to realize the fusion and interaction of physical space and information space. However, digital twin technology is still in the

FIGURE 1: Opera culture.

theoretical research stage. The research on the application of digital twin is also in the stage of exploration and practice [11]. Digital twin is a simulation process that integrates multidisciplinary, multiphysics, multiscale, and multi-probability by making full use of physical model, sensor update, operation history, and other data. It completes the mapping in the virtual space, thus reflecting the whole life cycle process of the corresponding physical equipment. It is shown in Figure 2:

Figure 2 shows the industrial digital twin focuses on the simulation of complex mechanical entities in the physical world in the design, manufacture, and use stages. It seeks to establish an accurate mapping of the physical world in the digital world through a large amount of sensor data and material physical property data. The industrial digital twin uses artificial intelligence technology as a means, combined with spatial geographic information technology, and independently developed a one-stop digital twin service for the entire industry chain. It also empowers data through the comprehensive use of big data and Internet of Things technology and drives the penetration of "intelligence +" in various segments. It has the following properties:

Multiphysics: the product digital twin needs to describe the geometric characteristics of the corresponding physical product, various physical characteristics, and environmental information in the use and service phases of the product. The design of the opera culture platform requires a digital mapping model of physical products based on physical characteristics [12].
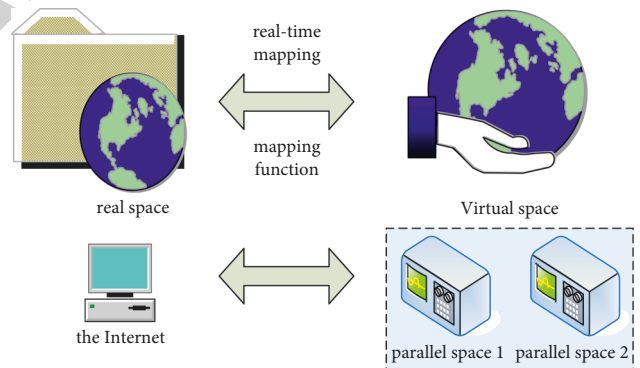


FIGURE 2: Principles of industrial digital twin technology.

Dynamic: during the whole life cycle of a real device, the information of opera culture in the real device will be reflected in the virtual digital twin device. The virtual digital twin device can also monitor the dissemination process and usage of opera culture in real time [13].

Through these analyses, it believes that it is feasible to combine the traditional opera culture platform with the industrial digital twin. It can focus on the real-time mapping, simulation, and remote control of the digital twin in the stage of opera cultural performance. It can improve the intelligence of opera culture in the direction of intelligence, dissemination, and dynamic automatic optimization of planning and deployment [14].

*3.3. 3D Transformation Algorithms.* 3D graphics transformation is the process of transforming the original 3D graphics into a new 3D graphics after translation, scaling, and rotation. A spatial position is corresponded by a point in space, and a direction is corresponded by a vector. Both can be represented by three-dimensional vectors [15]. Three-dimensional graphics transformation is divided into geometric transformation and projection transformation. The basic geometric transformations are all relative to the coordinate origin, coordinate axes, and coordinate planes. It includes translation, scaling, rotation, symmetry, and offset.

However, the translation transformation cannot be represented by such a matrix, so it follows the homogeneous notation. The point in space is denoted by

$$P = (p_a, p_b, p_z, p_w)_{4 \times 1}. \tag{1}$$

There are $p_w = 1$ of them. In this way, the homogeneous matrix multiplied by the transformation matrix is sufficient to express the changes of the three-dimensional graphics. Then, the transformation of homogeneous coordinates can become a three-dimensional transformation matrix such as

$$[a' \ b' \ z' \ 1] = [a \ b \ z \ 1]T_{3D}. \tag{2}$$

The above $4 \times 4$ matrix can be divided into four submatrices according to different graphics transformation functions, such as

$$T_1 = \begin{bmatrix} a & b & c \\ d & e & f \\ g & h & i \end{bmatrix}. \tag{3}$$

Equation (3) is a $3 \times 3$ order submatrix. It corresponds to three-dimensional transformation: symmetry transformation, scale change, rotation, and staggered transformation

$$T_2 = [l \ m \ n]. \tag{4}$$

$T_2$ is a $1 \times 3$-order matrix, which corresponds to the translation transformation of the point in the three-dimensional transformation, as in the following:

$$T_3 = \begin{bmatrix} p \\ q \\ r \end{bmatrix}, \tag{5}$$

$T_3$ is a matrix of order $3 \times 1$, which corresponds to perspective transformation in three-dimensional transformation. It assumes that there is a point P in three-dimensional space waiting to be transformed. Its original coordinate is $p(a, b, z)$. After three-dimensional geometric transformation, the coordinate of this point changes to $p'(a', b', z')$.

If the point is obtained after the point P is translated and transformed, it can be expressed as

$$[a' \ b' \ z' \ 1] = [a \ b \ z \ 1]T_t = [a + T_a \ b + T_b \ z + T_z \ 1]. \tag{6}$$

If the result of $a + T_a$, $b + T_b$, and $z + T_z$ are negative, it means that its movement direction is the negative direction of the coordinate axis. If the point P is scaled, $p'$ can be expressed as (7) in the following form:

$$[a' \ b' \ z' \ 1] = [a \ b \ z \ 1]T_s = [ax \ ey \ iz \ 1], \tag{7}$$

$a$, $e$, $i$ are the scaling factors in the $x$, $y$, and $z$ directions, respectively. When $a = e = i$, it means that it performs the overall scaling. When they are not equal, it means that it performs local scaling. In this way, the scaling ratios of the three directions are not equal, and the original object will be deformed.

If the object is rotated around the coordinate axis, $p'$ can be expressed in the form of Equations (8)–(10):

When it rotates around the $z$-axis, it is represented as

$$[a' \ b' \ z' \ 1] = [a \ b \ z \ 1]T_{rz} \\ = [a\cos\theta - b\sin\theta \ a\sin\theta + b\cos\theta]. \tag{8}$$

When it rotates around the $x$-axis, the representation is as shown in:

$$[a' \ b' \ z' \ 1] = [a \ b \ z \ 1]T_{ra} \\ = [a \ b\cos\theta - z\sin\theta \ b\sin\theta + z\cos\theta \ 1]. \tag{9}$$

When it rotates around the $y$-axis, it is expressed as

$$[a' \ b' \ z' \ 1] = [a \ b \ z \ 1]T_{rb} \\ = [z\sin\theta + a\cos\theta \ b \ z\cos\theta - a\sin\theta \ 1]. \tag{10}$$

Among them, $\theta$ represents the rotation angle of the object. It transforms the object that was originally in the form of a three-dimensional image and finally displayed in the form of a two-dimensional image, which is called projective transformation [16]. Projection transformation is the process of transforming the coordinates of one map projection point into the coordinates of another map projection point. It studies the theory and method of coordinate transformation of projected points. Perspective and parallel projections are two of the more commonly used types of geometric plane projections. The unity3D engine will perform mutual conversion between the two projections according to the specific situation, as shown in Figure 3:

As shown in Figure 3, parallel projection is the projection of graphics onto the projection surface along parallel lines, which can ensure that the relative proportions of objects do not change. Perspective projection is the projection of graphics onto the projection surface along a straight line that converges to the projection center, which can produce a sense of reality near large and far small [17, 18]. If the light source S moves to infinity, the projection lines become parallel lines, and the projection of the object is not affected by the distance change. The projection method in which the projection lines are all parallel to each other is called the parallel projection method.

Figure shows the principle of projection transformation, which is similar to the pinhole imaging phenomenon. In the 3D space, the point P takes the origin as the projection center, and now it is necessary to calculate the new $y$ coordinate [19]. From similar triangles, it can be known that
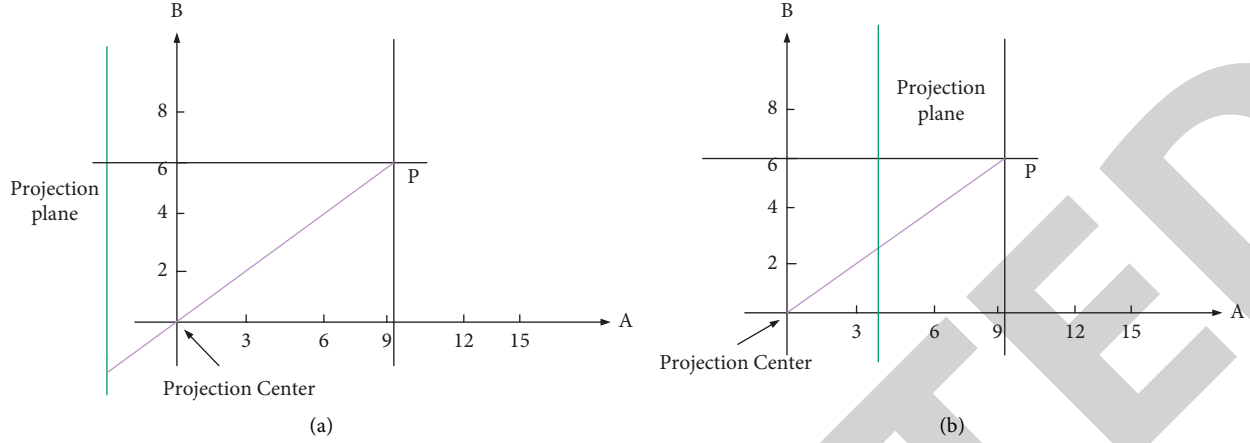
FIGURE 3: Parallel projection in digital twin technology. (a) The principle of projection transformation. (b) The projection transformation principle after converting the projection plane.

$$\frac{-pb'}{d} = \frac{pb}{z}.\qquad(11)$$

It leads to

$$pb' = \frac{-dp_b}{z}.\qquad(12)$$

Therefore, the result of the projection of the point $P(a, b, z)$ through the origin to the plane $Z = -d$ is

$$p' = \begin{bmatrix} a' \\ b' \\ z' \end{bmatrix} = \begin{bmatrix} \dfrac{-da}{z} \\ \dfrac{-db}{z} \\ -d \end{bmatrix} = \frac{-1}{dz}\begin{bmatrix} a \\ b \\ z \end{bmatrix}.\qquad(13)$$

In practical applications, the minus sign would cause unnecessary complexity. The $p'$ at this time is

$$p' = \begin{bmatrix} a' \\ b' \\ z' \end{bmatrix} = \begin{bmatrix} \dfrac{da}{z} \\ \dfrac{db}{z} \\ d \end{bmatrix} = \frac{1}{z_d}\begin{bmatrix} a \\ b \\ z \end{bmatrix}.\qquad(14)$$

When it transforms a 4D homogeneous vector into 3D, it divides the 4D vector by $p'$. It can be reversed to obtain the projection matrix as

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & \dfrac{1}{d} & 0 \end{bmatrix}\begin{bmatrix} a \\ b \\ z \\ 1 \end{bmatrix} = \begin{bmatrix} a \\ b \\ z \\ \dfrac{z}{d} \end{bmatrix}.\qquad(15)$$

The visual angle display of UI interface is related to its three-dimensional graphics transformation and projection transformation. According to the above derivation, the digital twin opera platform can be built more accurately [20, 21]. The objective function is the performance criterion of the system. It includes lightest weight of a structure, the lowest cost, the most reasonable form, the shortest production time of a product, and the minimum energy consumption. The objective function is given as

$$\min \sigma = \min \sqrt{\frac{1}{N}\sum_{i=1}^{N}(a_i - 1)^2}.\qquad(16)$$

It uses the standard deviation to describe the degree of dispersion among the opera platforms. The degree of dispersion requires the most average, that is, the smallest standard deviation. It is

$$a_i = \int_{t_1}^{t_2} \Phi\,\mathrm{dt}.\qquad(17)$$

## 4. Design of an Opera Culture Platform Based on Digital Twin

The functional design of the digital service platform can be divided into three categories: management and promotion, teaching assistance, and experiential learning. Therefore, the platform is divided into three modules: the opera culture education management subplatform, the opera culture teaching assistance subplatform, and the learning experience subplatform. Through the construction of three modules, it systematically optimizes the management and promotion of opera culture and assists the development of related work of opera culture. It strengthens students' experience and interest in traditional arts, so as to promote the development of traditional culture popularization education.

### 4.1. System Design Principles.

Consistency principle: generally speaking, the principle of consistency means that in the process of platform

design and development, different user terminals and different modules should be highly consistent in terms of design concepts, model architecture, data standards, etc., so as to facilitate the promotion and maintenance of the platform [22, 23]. At the same time, a unified data standard should be established to facilitate the storage, transmission, and processing of opera resources of different media types [24]. In addition to maintaining the above consistency requirements, the consistency between "emotion" and "environment" should also be highlighted.

Targeted principle: only by guiding users to enter the situation spontaneously to experience, can better results be achieved. Therefore, in the design process, the different needs of different users should also be considered when the technical standards and "situation" are consistent. Aiming at the different users' focus and habits, diversification and pertinence should be emphasized in the operation interface and user management.

Interactivity principle: good interactivity is one of the basic principles of digital platform design. To give full play to the situational advantages and rely on the Internet and mobile platforms for development and design, the interactive function should be highlighted [25]. The interaction and experience functions are the main highlights of the design and development of this platform based on the theory of situational education. In order to meet the needs of Sichuan Opera's full experience and interaction based on "situation," this platform should have functions such as chatting, resource sharing, resource publishing and retrieval, and VR experience.

*4.2. System Architecture Design.* The design of the digital platform of opera culture should be based on the mobile terminal application APP and the web terminal management background. The mobile phone application can help the teaching subject to carry out the teaching work more effectively, and the students can better learn and understand the opera culture. The organizer can upload the prepared opera cultural materials through the web page of the platform system, and users can learn through mobile phones after simple settings, as shown in Figure 4:

As shown in Figure 4, the Web terminal is the management core of the Sichuan Opera digital education service platform. The user of the management subject supervises and manages the activity process and evaluates the activity effect through the web terminal. The teaching subject uploads relevant courseware through the Web terminal and provides guidance on the acceptance of the subject to teaching. There is a good interactive experience on the web side, and users do not need to refresh the page again. It also acquires data asynchronously through Ajax, and the page displays smoothly.

WEB mainly consists of five parts: user management, process management, promotion management, teaching management, and information management. Information
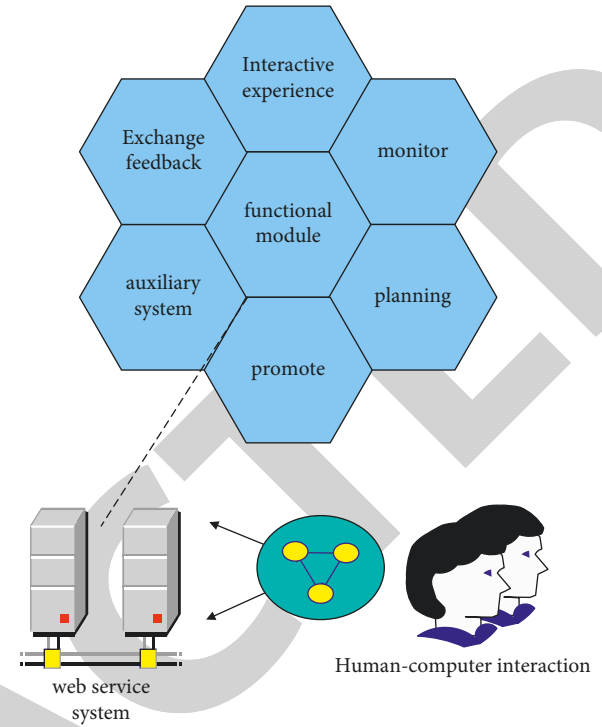


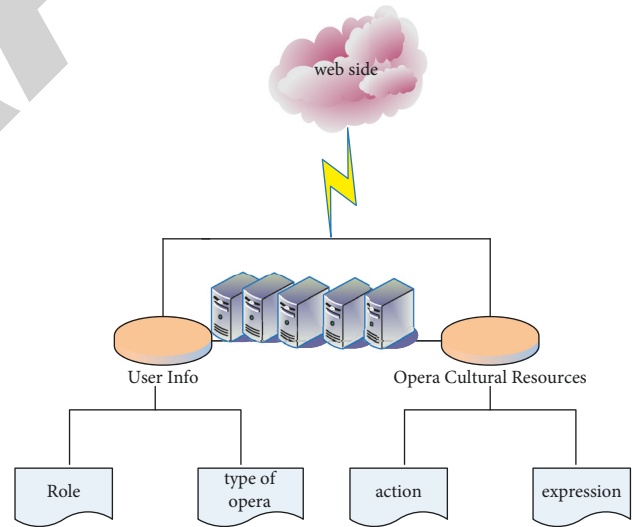Figure 4: Design of the digital platform for opera culture.



Figure 5: Web-side functional flow chart.

management reminds students of their evaluation and feedback information after activities. The teaching subject can grasp the students' learning situation in time. The functional flow chart of the WEB terminal is shown in Figure 5:

As shown in Figure 5, the main participants of the opera entering the campus are the management learning and teaching. Therefore, the system of the mobile terminal of the digital platform should be designed according to the needs of different participants. Among them, the main body of management mainly manages the resources of opera culture through the web terminal.

*4.3. Platform Functional Requirements and Implementation-Taking Sichuan Opera as an Example.* Through the functional structure of Sichuan Opera interactive experience platform, the system should have experience management function, real-time experience function, and experience communication function.

*4.3.1. Experience Management Function.* This function of the system is designed to meet the needs of the teaching subject. The teaching subject can perform necessary management control on the interactive experience module through the terminal. It mainly includes configuring the data resources required by the experience project and regularly updating the data such as Facebook and dressing up. In addition to Sichuan Opera face-changing and Sichuan Opera costumes, it adjusts other unique experience types according to needs, collects experience feelings, and solves problems in the experience.

*4.3.2. Real-Time Experience Function.* This function is the core function of the system. It can be used by the subject of teaching to interact with relevant content according to personal interests, and it can also be used by the subject of teaching to experience. It mainly includes Sichuan Opera face changing experience, Sichuan Opera dressing experience, Sichuan Opera other unique experience, etc. Because face-changing art is the essence of Sichuan Opera, it plays a more prominent role in the promotion of Sichuan Opera. For this reason, it will be listed separately from the unique experience of Sichuan Opera, so that users can choose the experience.

*4.3.3. Interactive Communication Function.* This function is for the subject of teaching to exchange feelings with each other according to the experience situation, and for the subject of teaching to communicate with the subject of teaching the specific situation of a certain content. The subject of teaching answers the questions of the subject. This function is an important way for teachers to lead and control the experience process in the popular situational education activities of Sichuan Opera. It mainly includes experience content barrage exchange, post-experience message, experience forum, etc.

The experience management module needs to have the functions of data resource configuration and update, adjustment and setting of experience content, statistics of experience information, and management of experience exchanges. It logs in on mobile terminals such as mobile phones and relies on the system-wide media data center according to the set permissions. Based on streaming media server and portal server, it uploads or publishes various digital resources about the interactive experience of opera [26]. In the process of user experience, it collects user experience data and manages user interaction information based on a distributed interactive platform.

The real-time experience module is the core part of the Sichuan Opera interactive experience platform, and it is also the key and difficult part of the design. It is mainly the design of the experience content and the way of experience. According to the system functional requirements, this module must have three basic functions: face-changing experience, dress-up experience, and unique experience. It utilizes real-time, accurate gesture dynamic tracking, and facial recognition technology to call the system camera. It tracks the face through the camera and covers the face with hands to trigger interactive commands to change the face. This is very close to the real Sichuan Opera face-changing performance experience.

This session will rely on the reality technology based on digital twin to integrate virtual characters with real scenes. The experience object can choose any place suitable for performance in reality to perform. Different from face changing and dressing up experience, the former is experienced on a virtual stage, while the latter is experienced by virtual characters in an environment consistent with reality. The experience object uses the mobile APP with augmented reality function to detect the environment through the camera, and the real environment is reproduced in the mobile phone.

*4.4. International Cultural Communication Strategy Based on Digital Twin Technology*

*4.4.1. About Cultural Communication.* The channels of cultural dissemination include commercial activities, population migration, education, etc. Cultural diffusion is also called cultural diffusion. The main means of modern cultural dissemination is mass media. Cultural exchange can promote the development of world culture. In the era of globalization, every country is committed to improving its economic, political, and military competitiveness in the world. "Soft power," that is, the improvement of the national spiritual and cultural level, also plays a pivotal role. Throughout the world, cultural competition and dissemination has become a historical trend. The dissemination of culture enables the integration of cultures between countries and promotes the production of diverse and characteristic cultures through exchanges.

Today, the world is in the era of digital existence, and the rapid development of information technology has changed the ideas and methods of various communication organizations. The inheritance of culture is an eternal theme. Culture is the soul of a nation and the spiritual pillar for the survival, development, and reproduction of a nation. With the establishment of China's digital culture international dissemination platform, it not only enhances China's cultural content dissemination ability but also enhances the accumulation of China's intellectual property products with international market value.

*4.4.2. The Role of Digital Twin Technology in International Cultural Communication.* In today's era, culture has increasingly become an important source of national cohesion and creativity. It has increasingly become an important factor in the competition of comprehensive national

strength. However, because China's cultural content industry has been mainly targeting the Chinese market and audience for a long time, it is not familiar with the new market and new audience brought by international opportunities, and does not know enough about the characteristics and needs of the international cultural consumption market. It lacks content offerings and sales channels to enter key markets. Therefore, content products formed only by subjective judgments cannot really produce large-scale market sales and even cannot be accepted by consumers in the target market.

Therefore, if we want to establish an international development strategy for China's cultural content industry, it is urgent to combine digital twin technology with an industrial platform. It is necessary to collect, record, analyze, and judge the user consumption behavior and orientation of the international cultural consumption market and establish a targeted content production direction. This in turn opens up international communication and sales channels for Chinese cultural content products and provides a basic application demonstration for the establishment of a global operation service platform. It finally forms a profitable global operation service platform that can support the internal and external two-way flow of digital cultural content on a global scale, as shown in Figure 6:

As shown in Figure 6, the evaluation feedback system established based on digital twin technology can record and analyze the content selection tendency, usage behavior trajectory, content reading behavior characteristics, and effective user interface of international users from multiple perspectives and multiple level of complex analytical data. It can be combined from multiple dimensions such as hardware environment and network environment and provides valuable guidance for optimizing the propagation direction, propagation mode, user services, and other important links. This saves the cost of dissemination, improves the efficiency of dissemination, enhances the country's core competitiveness, and better enters the international perspective.

## 5. Experiment and Analysis of International Cultural Communication Based on Digital Twin Technology

*5.1. Comparative Experiment and Analysis of International Cultural Communication under Different Communication Modes.* Compared with hardware factors such as the country's gross national product and urban construction, the "national soft power" with cultural charm as the main component has gradually developed into an important indicator to measure the country's comprehensive strength. The economic benefits brought by international cultural dissemination to China in recent years are shown in Table 1:

As shown in Table 1, in the new media era with the rapid development of network technology, the previous forms of communication such as newspapers, television, and radio will be replaced by the Internet. International cultural communication can be communicated to the public through various digital communication methods. This paper compares the
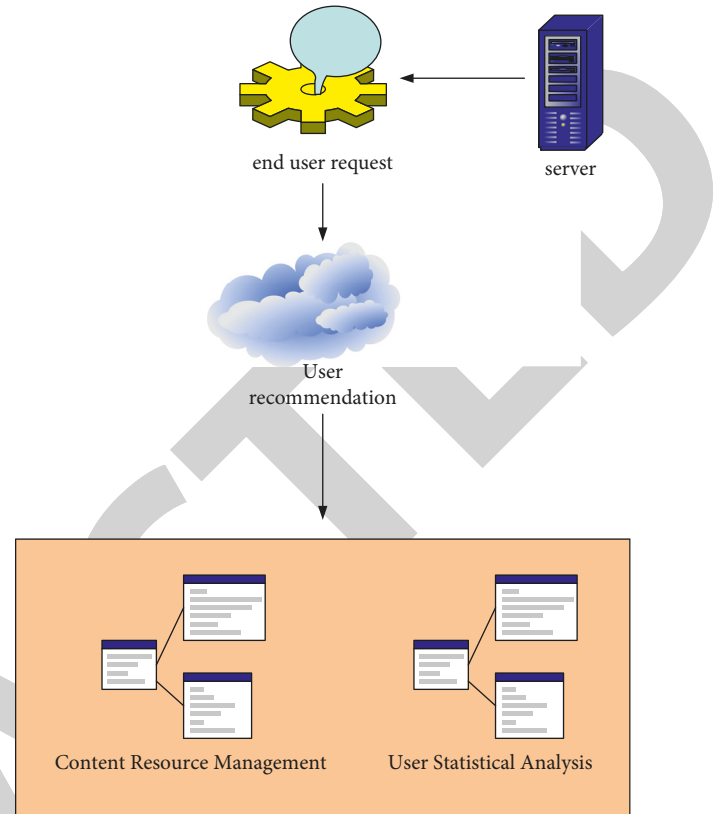


Figure 6: International cultural dissemination based on digital twin technology.

Table 1: Economic benefits brought by international cultural dissemination to China in recent years.

| Years | Income (billion) | Year-on-year increase | Growth rate (%) |
| --- | --- | --- | --- |
| 2015 | 321.54 | 0 | 0 |
| 2016 | 358.89 | 37.35 | 10.4 |
| 2017 | 435.86 | 76.97 | 17.6 |
| 2018 | 457.64 | 21.78 | 4.7 |
| 2019 | 507.30 | 49.66 | 9.7 |

propagation through traditional methods and methods based on digital twin technology in recent years, as shown in Figure 7:

As shown in Figure 7, in the environment of new technology and new media, it can achieve active dissemination. It actively pushes information to users with potential needs through an interactive platform based on digital twin technology and actively promotes the research of relevant historical materials. It uses the various advantages of the Internet and digital technology to carry out interactive, single-theme distance teaching, which amplifies the significance of international cultural communication.

Information about various cultures is disseminated through media such as newspapers, radio, television, and the Internet. After the audience receives this information, they gain cultural knowledge accumulation. Compared with before, its cognition of culture has changed to some extent. However, under the previous form of cultural dissemination, the audience generally has high recognition and low
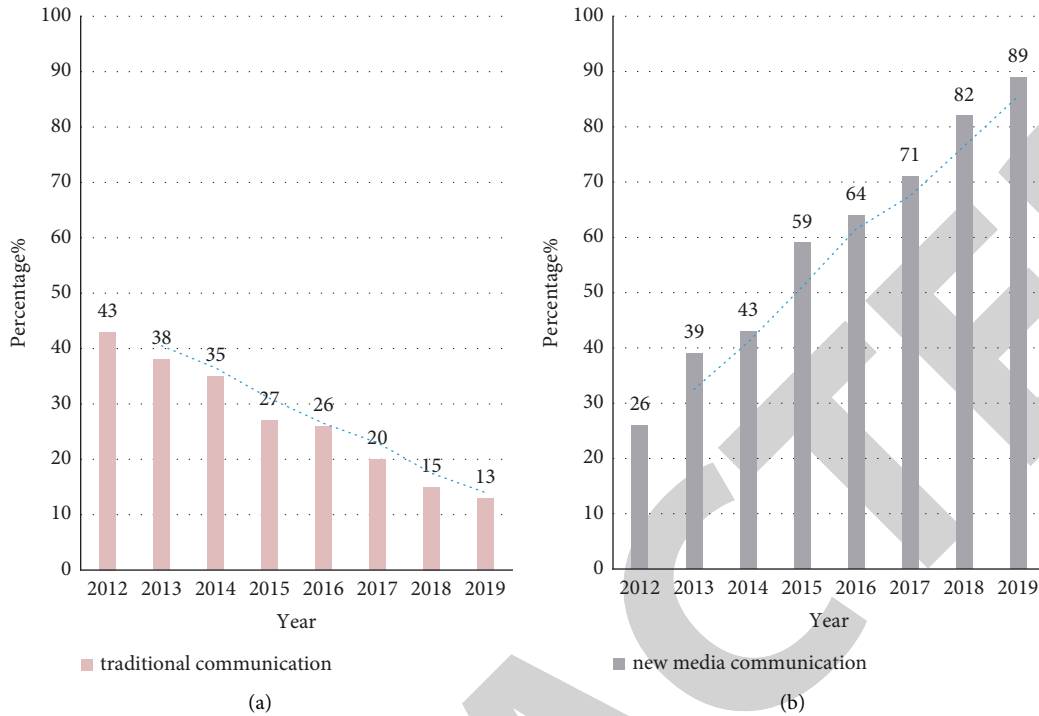
Figure 7: Comparison of traditional methods and methods based on digital twin technology. (a) Development trend of traditional communication. (b) Development trend of communication based on digital twin technology.

recognition of traditional culture. This article surveys 100 people who love international culture. Their basic information is shown in Table 2:

As shown in Table 2, among the 100 surveyed people, the ratio of male to female is basically the same. In terms of age, there are more people aged 25–40 years. In terms of education, the proportion of junior high school and above is more.

This article analyzes the 100 people's recognition and awareness of international culture, as shown in Tables 3 and 4:

As shown in Tables 3 and 4, most of the public have a strong sense of identity with a long-standing international culture. It can be seen that the public's basic recognition of international culture is very high. There are 51 people who identify with international culture very much, accounting for 51%. But only 12 people are aware of international culture, accounting for 12%. However, the vast majority of the interviewed public did not have a deeper understanding and awareness of various traditional cultures. Many interviewees indicated that they had knowledge and heard of these cultures, but they did not have a deeper exploration of the cultural spirit contained in them. There are also some urban youth groups interviewed that their cognition of culture is mostly limited to books and "impression" understanding and still lacks understanding of connotation.

"Internet +" is a brand-new business form in which the Internet has developed to a certain stage. At present, its application fields have spread all aspects of life. This includes the dissemination and application of traditional culture. This paper analyzes the increase in the scale of Internet users in recent years, as shown in Figure 8:

Table 2: Basic information of 100 people who love international culture.

| Basic situation | Object | Number of people |
| --- | --- | --- |
| Age | 25–40 | 55 |
| | Greater than 40 | 45 |
| Gender | Male | 47 |
| | Female | 53 |
| Educational level | Below junior high school | 22 |
| | Junior high school or above | 78 |

As shown in Figure 8, the survey shows that with the continuous development and change of the current media social environment, the audience is very interested in the dissemination of "Internet +" traditional culture. In the era of mobile Internet, the way audiences receive information has changed. The Internet has injected new vitality into the development of traditional culture. The application of traditional culture has become an important form of traditional cultural information dissemination.

This paper analyzes the attitudes of Internet users towards international cultural communication, as shown in Figure 9:

As shown in Figure 9, there are both positive and negative attitudes towards the current Internet international cultural dissemination, but most of them have a positive attitude towards the development of "Internet +" traditional culture. The audience's positive attitude towards the "Internet +" traditional culture shows that the audience has certain confidence in its development, indicating that the audience's attention to the Internet traditional culture is

TABLE 3: 100 people's recognition of international culture.

| Acceptance | Number of people | Percentage (%) | Effective percentage (%) |
| --- | --- | --- | --- |
| Very much agree | 51 | 51 | 51 |
| Identify | 30 | 30 | 30 |
| Neither agree nor disagree | 10 | 10 | 10 |
| Not agree | 5 | 5 | 5 |
| Strongly disagree | 4 | 4 | 4 |

TABLE 4: 100 people's awareness of international culture.

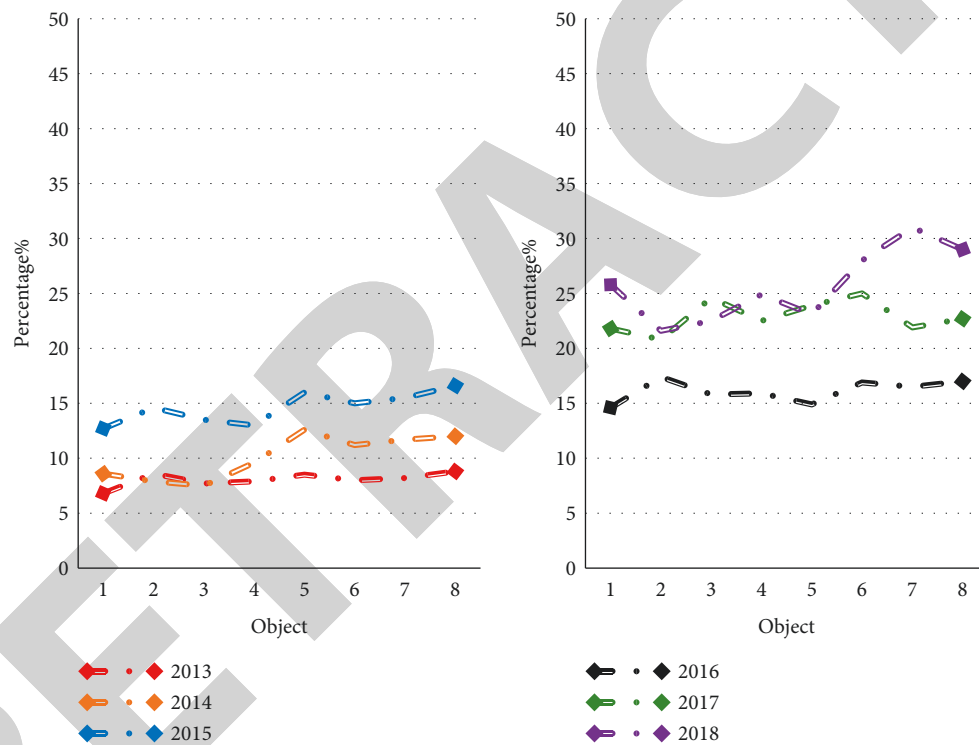| Acceptance | Number of people | Percentage (%) | Effective percentage (%) |
| --- | --- | --- | --- |
| Know very well | 12 | 12 | 12 |
| General understanding | 20 | 20 | 20 |
| Do not understand | 43 | 43 | 43 |
| Very ignorant | 25 | 25 | 25 |



FIGURE 8: Increase in the scale of Internet users from 2013 to 2018.

gradually increasing. To a certain extent, this shows that the audience's interest in international culture on the Internet has increased.

## 5.2. Implementation of International Cultural Communication Strategy

### 5.2.1. Fully understand the Cultural Background. When engaging in cross-border communication of cultural brands, understanding the cultural background and mental characteristics of the audience in the importing country is the first task for cultural brand operators to do well. From the perspective of positioning, the audience is always the first to accept the things that already exist in the mind. For Chinese

cultural brands, how to combine the value connotation conveyed by their own brands with the mental characteristics of overseas audiences is the key factor to take the lead in communication. This requires people's operators to pay attention to overseas audience market research and to put an end to the "product"-based communication strategy.

### 5.2.2. In-Depth Research on Cultural Products. It is necessary to conduct in-depth research on the consumption experience habits of cultural products of overseas audiences, and based on this, it enrich the experience and technological extension of their own culture. Chinese culture often has problems of monotonous experience and monotonous content. It needs to make extensive use of the opportunities
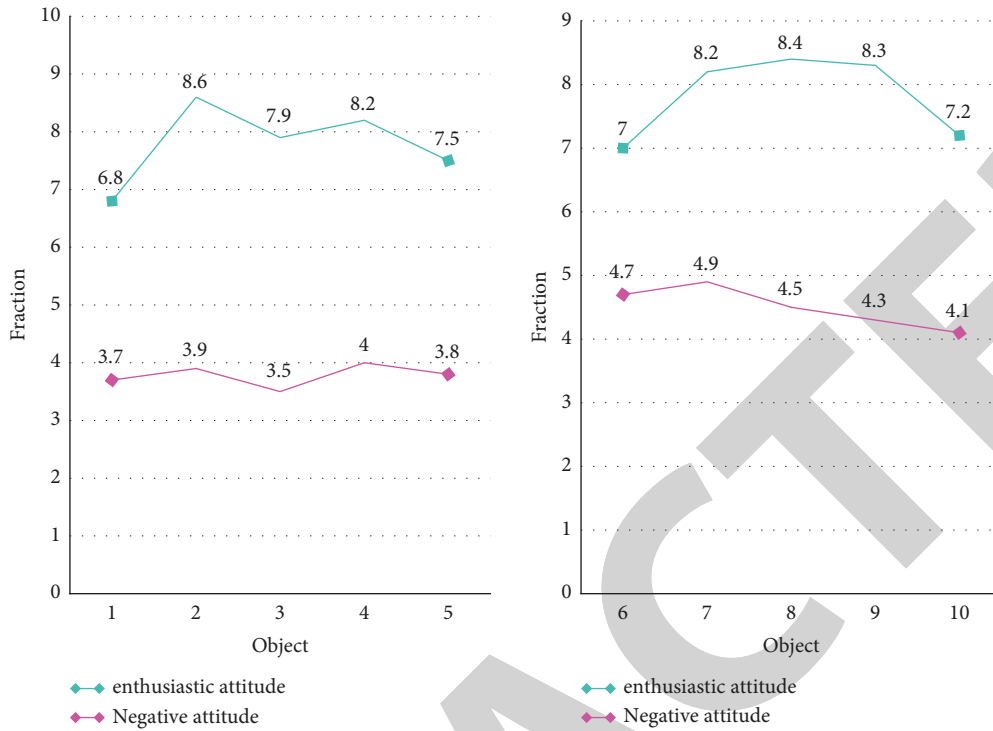
FIGURE 9: Attitudes of Internet users towards international cultural communication.

brought by technological innovation to create a variety of brand display and experience forms. This comprehensive brand communication strategy needs to be adopted to maintain the vitality and freshness of the brand.

*5.2.3. Adhere to the Unique National Character of the Brand.* It is necessary to adhere to the unique national character of the brand and emphasize cultural communication and mutual learning. Unique nationality is the core selling point of cultural brands in international communication. Although it is necessary to consider the acceptance habits and mental characteristics of overseas audiences in terms of communication methods and strategies, it is still the core competitiveness of the brand nationality that can move people's hearts. To let the audience understand that the nationality of cultural brands is not something illusory, it is necessary to carry out cultural communication and mutual learning, such as in communication. It is necessary to appropriately adopt a light and lively humorous form to bring the seemingly inscrutable Chinese culture closer to the hearts of ordinary overseas people.

## 6. Conclusions

Driven by new media, through visual design, the story of opera is transformed into visual images and applied to digital image interaction. In the process of unintentional interaction, the public realizes the understanding and perception of the opera culture through the change and collision of thinking, thus awakening the public's perception and attention to the opera culture. Now opera is the main body of cultural activities in civil society. Chinese opera embodies

the most extensive aesthetic taste and appreciation taste and has become the unanimous hobby of many people from urban to rural areas. Opera is also an important carrier for disseminating traditional Chinese cultural values. In the media selection of opera culture, it should face the media carrier with publicity and mass. Ontology can be better spread only if it constantly adapts to social and cultural needs and aesthetics. With the development of digital twin technology, people have begun to apply this technology to the design of opera cultural platforms and the dissemination of international culture. This paper expounds the design of the platform of opera culture and the concept of international cultural dissemination. In the Methods section, some methods of digital twins are described. Through analysis, we know that international cultural communication is very important for a country. It can not only satisfy people's spiritual needs but also improve economic efficiency. In the experimental part, this paper analyzes the traditional dissemination method and the dissemination method based on digital twin technology and finds that the dissemination method based on digital twin technology is more popular. Due to the complexity of cultural origins, cultural dissemination methods and paths, and factors that affect the diffusion, it is difficult to explore the origin of a certain cultural feature in cultural geography research.

## Data Availability

No data were used to support this study.

## Conflicts of Interest

The author declares that there are no conflicts of interest.

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## References

[1] C. Cui, Y. Zhao, and L. Wang, "Protection and dissemination of Chinese intangible cultural heritage based on digital games," *International Communication of Chinese Culture*, vol. 8, no. 4, pp. 483–491, 2021.

[2] J. J. Hoguane, M. N. Tavares, and S. Boto, "The use of media convergence in the preservation and dissemination of cultural assets," *International Journal of Creative Interfaces and Computer Graphics*, vol. 11, no. 2, pp. 16–26, 2020.

[3] V. Barrile, A. Fotia, G. Candela, and E. Bernardo, "Geomatics techniques for cultural heritage dissemination in augmented reality: bronzi di Riace case study," *Heritage*, vol. 2, no. 3, pp. 2243–2254, 2019.

[4] H. Zhang, Q. Liu, X. Chen, D Zhang, and J. Leng, "A digital twin-based approach for designing and multi-objective optimization of hollow glass production line," *IEEE Access*, vol. 5, pp. 26901–26911, 2017.

[5] C. Zhuang, J. Liu, H. Xiong, Ding X, and G. Weng, "Connotation, architecture and trends of product digital twin," *Computer Integrated Manufacturing Systems*, vol. 23, no. 4, pp. 753–768, 2017.

[6] N. Kuznetsova, T. Karlova, and A. Bekmeshov, "Building a digital twin of the main automated systems of an industrial enterprise to determine the level of information security," *Ergodesign*, vol. 2021, no. 2, pp. 97–102, 2021.

[7] Z. Hu, X. Fang, and J. Zhang, "A digital twin-based framework of manufacturing workshop for marine diesel engine," *International Journal of Advanced Manufacturing Technology*, vol. 117, no. 11-12, pp. 3323–3342, 2021.

[8] F. Yang, T. Wu, R. Liao, Jiang J, and B. Gao, "Application and implementation method of digital twin in electric equipment," *Gaodianya Jishu/High Voltage Engineering*, vol. 47, no. 5, pp. 1505–1521, 2021.

[9] F. . Psarommatis, "A generic methodology and a digital twin for zero defect manufacturing (ZDM) performance mapping towards design for ZDM," *Journal of Manufacturing Systems*, vol. 59, no. 2, pp. 507–521, 2021.

[10] T. Zhang and S. Sun, "An exploratory multi-scale framework to reservoir digital twin," *Advances in Geo-Energy Research*, vol. 5, no. 3, pp. 239–251, 2021.

[11] W. Qian, Y. Guo, K. Cui, P. Wu, D Fang, and W. Liu Fang, "Multidimensional data modeling and model validation for digital twin workshop," *Journal of Computing and Information Science in Engineering*, vol. 21, no. 3, pp. 1–52, 2021.

[12] F. Granelli, R. Capraro, M. Lorandi, and P. Casari, "Evaluating a digital twin of an IoT resource slice: an emulation study using the ELIoT platform," *IEEE Networking Letters*, vol. 3, no. 3, pp. 147–151, 2021.

[13] S. Ferguson, E. Bennett, and A. Ivashchenko, "Digital twin tackles design challenges," *World Pumps*, vol. 2017, no. 4, pp. 26–28, 2017.

[14] J. Pang, Y. Huang, Z. Xie, J Li, and Z. Cai, "Collaborative city digital twin for the COVID-19 pandemic: a federated learning solution," *Tsinghua Science and Technology*, vol. 26, no. 5, pp. 759–771, 2021.

[15] J. Lee, "Integration of digital twin and deep learning in cyber-physical systems: towards," *Smart Manufacturing*, vol. 38, no. 8, pp. 901–910, 2020.

[16] L. A. Rocha, "Music iconography, opera, gender and cultural revolution - the case study of the kwok on collection (Portugal)," *Studia Musicologica*, vol. 59, no. 3-4, pp. 365–398, 2018.

[17] M. L. Caldognetto, "Al confine tra l'italiano e le altre lingue: esperienze e riflessioni di un'operatrice culturale all'estero in contesto migratorio," *Éducation et sociétés plurilingues*, no. 46, pp. 71–82, 2019.

[18] N. . Vilkner, "The opera and the omnibus: material culture, urbanism and boieldieu's La dame blanche," *Cambridge Opera Journal*, vol. 32, no. 1, pp. 90–114, 2020.

[19] C. Hofer, G. Lechner, T. Brudermann, and M. Füllsack, "Adapting Axelrod's cultural dissemination model for simulating peer effects," *MethodsX*, vol. 4, no. C, pp. 1–10, 2017.

[20] M. Gao, "On the cultural dissemination of tao Teaching in the western world," *OALib*, vol. 07, no. 01, pp. 1–5, 2020.

[21] C. Helma, T. Cramer, S. Kramer, and L. De Raedt, "Data mining and machine learning techniques for the identification of mutagenicity inducing substructures and structure activity relationships of noncongeneric compounds," *Journal of Chemical Information and Computer Sciences*, vol. 44, no. 4, pp. 1402–1411, 2004.

[22] J. Y. Hong, H. Ko, and J. H. Kim, "Cultural intelligence and ARCS model for digital era," in *PROCEEDINGS OF THE 9TH INTERNATIONAL CONFERENCE ON WEB INTELLIGENCE, MINING AND SEMANTICS*, Seoul Republic of Korea, June 2019.

[23] Z. Lv* and H. Song, "Trust mechanism of feedback trust weight in multimedia network," *ACM Transactions on Multimedia Computing, Communications, and Applications*, vol. 17, no. 4, 2021.

[24] O. I. Khalaf and G. M. Abdulsahib, "Optimized dynamic storage of data (ODSD) in IoT based on blockchain for wireless sensor networks," *Peer-to-Peer Netw. Appl.*vol. 14, no. 2, 2021.

[25] R. S. Bhadoria and N. S. Chaudhari, "Pragmatic sensory data semantics with service-oriented computing," *Journal of Organizational and End User Computing*, vol. 31, no. 2, pp. 22–36, 2019.

[26] X. Gong, Y. Zhu, H. Zhu, and H. Wei, "Chmusic: A Traditional Chinese Music Dataset for Evaluation of Instrument Recognition," in *Proceedings of the ICBDT '21: 2021 4th International Conference on Big Data Technologies*, Zibo, China, September 2020.