Research Article

The Integration Mechanism of Music Intangible Cultural Heritage and Tourism Industry in the Internet of Things Environment

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This work aims to optimize and innovate the protection, inheritance, and dissemination of Intangible Cultural Heritage (ICH). Based on the Internet of Things (IoT), this work designs the music ICH development path under the cultural concept by integrating music ICH with the tourism industry in the smart city environment. Specifically, it innovatively proposes the integration mechanism of immersive scene design of music ICH with smart city's tourism industry in the Internet of Things (IoT) context. Consequently, the music ICH brand equity evaluation model is built. This model can evaluate the importance of cultural and asset value of music ICH. The comprehensive evaluation index system of music ICH mainly includes four primary indexes (with eight secondary indexes): the live performance, historical value, music audience, and the tourism industry integration. In addition, at the beginning of the model iteration, the pattern recognition accuracy of the traditional model is only 67.5%. Then, the recognition accuracy of the traditional model can reach 72.5% at the 500th iteration. In contrast, the average recognition accuracy of the improved model can reach 80%, and the highest can reach 82.5%. This work can provide technical support and guarantee for formulating and optimizing music ICH protection strategies.

1. Introduction

Intangible Cultural Heritage (ICH) refers to various traditional cultural expressions passed down from generation to generation, regarded by all ethnic groups as an integral part of their cultural heritage. In today's society, music ICH is facing unprecedented difficulties and challenges [1, 2]. First, most music ICH (Intangible Cultural Heritage) heirs live substandardly and have passed their prime years. On the one hand, the heirs nominated as representatives of National and Provincial Music ICH have attracted more attention from both the public, local government, and the state. Thus, their daily expenses are being covered, and additional supplements are offered. For example, the palace music of Lidan Khan has been included in the inventory of National Intangible Cultural Heritage [3]. Thus, it forms a relatively stable cultural system and has a good cultural market and living environment. However, with the upgrading aesthetic views and diversifying needs, traditional music ICH has gradually lost people’s favor. The performance opportunity reduction has reduced their income and the growth of some music programs, regardless of their age. The health problems of the heirs complicate their daily lives and even force them to earn a living otherwise. On the other hand, some inexperienced young actors are still learning and cannot give artistic-level onstage performances regularly. As a result, they no longer have a stable income to cover their daily expenses to sustain their pursuit of this art form.

Second, most ICH heirs are poorly educated, lacking a comprehensive view and a sustainable development mind [4]. Their skills and knowledge on ICH are acquired through repeated practice over time, almost without systematic learning strategies and replicable learning approaches. Worse still, some ICH heirs believe that “If the master teaches his life-learning to a disciple, the disciple might replace him in the industry, and the master will be left to...
starve”. As a result, some music ICH cannot be smoothly passed down to the next generations, thus accelerating the disappearance of music ICH [5, 6]. Economic development has brought significant challenges to the inheritance and protection of ICH. Under the background of the IoT, the forms of ICH protection begin to show the characteristics of three-dimensional and diversification. Among many kinds of ICH, music ICH is often the witness of the production and life of various regions and nationalities. Some music ICH still retains the traditional drum performance form, which is of great value for studying classical music history.

Thereupon, this work uses the Internet of Things (IoT) digital technology to conduct simulation research and designs the development path of music ICH under the cultural concept of integrating music ICH and the tourism industry. Then, the integration mechanism model of the smart city tourism industry and music ICH is proposed. The main logical structure of this work is as follows. Section 1 introduces the background of music ICH and explains the difficulties in protecting and inheriting music ICH. Section 2 introduces the research status of IoT and music ICH and studies the integration mechanism of cultural heritage and tourism. Then, Section 3 builds the brand equity evaluation model of music ICH based on the brand-building concept and a Neural Network (NN). In Section 4, the performance of the NN model before and after optimization is compared, and the results are analyzed by considering data transmission and model reliability performance. Finally, Section 5 summarizes and draws the research conclusion. This work has an important reference value for inheriting and disseminating music ICH.

2. Recent Related Work

2.1. IoT and the Dissemination of Music ICH. Regarding the relevant research on IoT technology, Kumar et al. [7] studied the revolutionary methods of IoT for future technology improvement. Many important research and investigations have been carried out through the enhanced technology of IoT. The research discussed the different challenges and key issues, architecture, and key applications of IoT. Meanwhile, the research also introduced the existing literature, explained their contributions to different aspects of the IoT, and discussed the importance of big data and its analysis of the IoT. Chhetri Bera [8] compared and summarized the IoT for a 5-Generation (5G) wireless system. The research found that 5G technology was effective in solving IoT-related issues. The research comprehensively reviewed the emerging technologies related to the 5G-supported IoT. It factored in the technical driver of 5G wireless technology, such as 5G new radio technology. Hossein Motlagh et al. [9] examined the relationship between the IoT and the energy sector and the impact of blockchain technology on energy policy-making and the energy economy in the smart grid context. The findings suggested that modern technologies, such as the IoT, have provided many applications in the energy field, from energy supply, transmission, and energy demand and distribution schedule. Lv [10] analyzed IoT-native devices’ security to meet the increasing needs of future social development. They improved the IoT environment to provide more convenience for people and reduce the data leakage risk. The outcomes indicated that the proposed Max-psn cache algorithm was superior to other traditional algorithms in hit rate and average response speed of centralized and distributed fog systems. Sadeeq Zeebaree [11] investigated the energy management structure of the IoT in the distributed system, reducing the restrictions on renewable energy and the cost of energy supply and energy operators. The research has an important reference value for optimizing physical network system structure. Javaid Khan [12] employed IoT equipment in medical care and recovery technology under the influence of the Corona Virus 2019 (COVID-19). The research revealed that the medical care technology based on Deep Learning (DL) and IoT could effectively improve medical care and service levels. In this industrial scenario, personnel should be aware of network security issues to prevent or minimize network security incidents and enterprise data leakage. Corallo et al. [13] conducted the literature review and research on network security awareness in the context of the Industrial Internet of Things (IIoT). They comprehensively summarized the theme of network security by analyzing how to deal with network security awareness in the context of IIoT. They concluded that IoT users could increase communication efficiency and privacy protection by paying enough attention to network security awareness.

At the same time, Su [1] studied the changing ICH in Tourism Commercialization for the research on ICH and tourism commercialization. The research chose a music ICH in Lijiang, China, as an example, using the Critical Heritage Research method to explore the value and composition of ICH from the perspective of music performers. The results showed that the ICH was constructed and inherited in the process of pluralistic and dynamic. Harris [14] researched music production and ICH protection in Uighur communities and discussed social embedded music production. The research focused on the community inheritance and protection of ICH, showing a significant reference value for the research and dissemination of music ICH. Tzima et al. [2] examined the potential of ICH and mobile technology to improve the understanding of local ICH and sustainability through educational intervention. They found that digital storytelling was an effective educational tool to acquire new knowledge and stimulate preschool children’s interest in waterwheel cultural assets. The production of digital storytelling was feasible in the classroom environment. Istvandity et al. [15] investigated the loss of music ICH in communities and museums. The research outlined how heritage was lost through private ownership, community archives, and institutionalized collection. The research was of far-reaching significance for ICH protection. Zhang et al. [16] tapped into the spatial pattern of ICH and its influencing factors. By analyzing the spatial distribution characteristics of music ICH, the research observed that traditional music ICH could achieve better inheritance and development effects in the IoT environment. Different from the previous literature, this work puts forward the integration model of the smart city tourism industry and music ICH, which improves the integration and innovation of ICH.
2.2. Tourism Mechanism Integrating Cultural Heritage. Regarding the cultural heritage and tourism mechanism, Vegheș [4] researched the sustainable development and inclusive growth mode of cultural heritage. The results unveiled that the contribution of cultural heritage to the sustainable development of local communities was not very relevant. It accurately expressed how individuals and institutions understand, care for, and enjoy cultural heritage. Süe and Sadik [17] studied the economic evaluation of cultural heritage tourism. They used the regional tourism cost method to evaluate the cultural heritage tourism value of PEGA Mongolia city, Turkey. Determining the economic value of cultural resources could determine the income value of rational resource utilization and ensure its sustainable transmission to future generations. Meanwhile, the research selected a nonmarket valuation method: the regional travel cost method, to obtain the economic value of PEGA Mongolia city. The results showed that the independent variables: total expenditure, monthly income, gender, marital status, family number, and family work, were the effects in the model. Merciu et al. [18] evaluated the economic value of cultural heritage based on the travel cost method to make a complex analysis of the relevant value of the heritage buildings of the Bucharest historical center. Then, the correlation of cultural heritage with the corresponding protection measures was revealed. The research employed regional travel cost and personal travel cost methods. Then, by applying Bravais’s Pearson linear correlation coefficient, they confirmed that the demand for cultural heritage sites was inversely proportional to travel cost and distance. The results reflected that demand also depended on other factors, such as the satisfaction of tourism experience and the income and motivation of tourists. Crespi-Vallbona [19] analyzed the tour guides of cultural heritage sites to analyze the determinants of participation, hedonism, knowledge, local culture, and nostalgia experiences. The finding discovered that tour guide strategies should be designed with strong, active participation and local culture. Chhabra et al. [20] reviewed cultural heritage literature and proposed an improved model to provide credibility for automatic rickshaw as a culturally, socially/economically, and environmentally feasible personalized transportation form. They reasoned that the local heritage experience of tourists could be enriched by meaningfully integrating amusement facilities into the heritage tourism package. It could serve as a cultural means of transportation to heritage attractions.

According to the literature review mentioned above, the attention to music ICH in the IoT environment is not great at present. ICH is dying out at a breakneck speed. The advantage of previous research is to improve the awareness of ICH. The main disadvantage is that the previous research on ICH inheritance and dissemination innovation is insufficient. Therefore, the research on integrating the tourism industry with music ICH has practical application value for enriching ways to inherit and disseminate music ICH.

3. Brand Equity Evaluation Model of Music ICH Based on NN

3.1. Brand Building of Music ICH. According to the traditional ICH brand building, the success of an influential music ICH brand usually goes through the brand embryonic stage, cognitive stage, and brand formation stage [21]. First, in the embryonic stage, the environment affects most ICH projects. Due to the poor regional economic development, ICH projects cannot adapt to social advancement. This situation is compounded by the shortage of professionals, weak awareness of ICH protection, and low network penetration. These factors make it difficult to protect, inherit, and pursue excellent ICH. Second, ICH projects have high brand awareness and reputation in the brand formation stage, and brand culture is becoming increasingly prominent. At the same time, relevant industrial clusters have been formed, and ICH projects are promoting regional economic development. The brand effect will innovate the concept of ICH and encourage more talents to join the ICH industry. Figure 1 analyzes the brand-building process of music ICH and gives its structural framework.

3.2. Model Processing and Optimization in Music ICH. The task of recognizing and classifying music ICH includes three main stages: music signal preprocessing, music feature extraction, and music genre determination [22]. Preprocessing is a fundamental step in music signal processing. It aims to facilitate feature extraction in the next stage. The extracted feature parameters the mapped expression of the music signal because the music signal initially contains large numbers of repetitions. The computational complexity will be very high if the time-domain audio signal directly enters the classification system. Finally, the extracted feature parameters are introduced into the classifier. The features are modeled by adjusting the classifier’s parameters. The best model obtained by training is used to determine the genre of the test music samples. Of these, the feature extraction module often uses traditional methods, and the extraction process is relatively complex. With the rapid development of Deep Learning (DL), autonomous feature learning models are gaining popularity in extracting deeper and more abstract features. Therefore, this work uses the Deep Belief Network (DBN) to learn the basic features of music ICH. Then, softmax regression prediction is used to test the genre of music samples and analyze the signal recognition and processing flow of music ICH. Convolution is the convolution kernel operation on the image matrix. The convolution kernel is a small window recording the weight. The convolution kernel slides on the input image in steps. It operates the input image of the corresponding area of the convolution kernel each time. It multiplies and adds the weight in the convolution kernel and the value of the corresponding input image. A value is assigned to the output feature amp corresponding to the center of the convolution kernel. Through efficient convolution, the music ICH model is processed and optimized, and the results are shown in Figure 2.
3.3. Video Detection and Feature Extraction of Music ICH.

According to the video composition of music ICH, the smallest video unit is a video frame. Due to the large size of the nonmodal video itself, it is unrealistic to extract and analyze each video’s features of adjacent image pairs [23]. Therefore, to improve the efficiency of video boundary detection, the target boundary region must be filtered first. Here, the high-level output of the network structure represents the video image feature that is compared with the adjacent image features to remove the area without shooting boundary. Figure 3 demonstrates the video data detection process of music ICH:

A linear expression describes the transition between shots. In addition to scene transition, the video interface of music ICH can also change light and shadow or interfere with the movement or occlusion of other objects. Therefore, if the video detection model only judges whether the detection support of adjacent keyframes is insufficient, the error is also large. One of the key points to be considered in video detection is to minimize the impact of interference information. At the same time, the information before and after the keyframe needs to be compared. Because of the above problems, the proposed music ICH brand equity evaluation model selects continuous frames (centered on the candidate boundary frames) as the input content. Doing so can reduce the interference error, such as brightness change in notch recognition. Additionally, the proposed model uses Convolutional Neural Network (CNN) technology to input multiple frames to distinguish gradient processing frames, shot-free boundary frames, and candidate boundary frames in video shot clipping detection. This method is convenient for multiclass parallel classification of video. This method is convenient for multiclass parallel classification of video. The classification process is unfolded in Figure 4.

As per Figure 4, the video scene recognition step of music ICH is divided into three parts. First, it extracts from video features the image information, such as pixels and edge features. Then, the similarity of video scenes is calculated, including inter-frame differences and statistical values. Finally, the video edge condition is judged based on the global threshold.

4. Results and Discussion

4.1. Comparison of Performance Results before and after Model Optimization.

This section studies the brand equity evaluation model of music ICH combined with tourism. The model performance under different parameters before and after optimization is compared. The accuracy and precision of model recognition before and after model optimization are plotted in Figure 5. At the same time, Figure 6 compares and analyzes the change curves of recognition recall and F1-value of different models with model iteration. In Figures 5 and 6, the black line represents the model recognition comparison results of the traditional model, and the red line is the performance change curve of the optimization model proposed here.

According to Figure 5, in the beginning, the model recognition accuracy of the traditional model is only 67.5%. Then, the recognition accuracy of the traditional model can reach 72.5% at the 500th iteration. By comparison, the average recognition accuracy of the improved model can reach 80%, with an 82.5% highest score. Thus, the performance of the improved model has greatly improved. Besides, the numeral results suggest that music ICH’s comprehensive evaluation index system mainly includes four primary indexes: intangible cultural heritage live performance, historical value, music audience, tourism industry integration, and eight secondary indexes. On the other hand, the recognition precision of the traditional model is only about 60%. In contrast, the recognition precision can reach 85% after optimization, with substantial improvement.

Figure 6(a) shows that at the 100th iteration, the recall of the traditional model is only 40%. In contrast, the recall of the optimized model has increased to 55%. At the 600th iteration, the recall of the traditional and optimization models reach 75% and 85%, respectively. From Figure 6(b),...
Figure 2: Flowchart of signal recognition and classification of music ICH.

Figure 3: Flowchart of video data detection of music ICH.
at the 500th iteration, the F1-values of the traditional and improved models are 70% and 90%, respectively. Comparing the performance of different models finds that the performance of the optimization model proposed here has been greatly improved.

4.2. Comparison of System Data Transmission and Model Reliability. Subsequently, the model reliability data and Data Transmission Rate (DTR) under different model iterations are sorted out in Figure 7.

Evidently, the reliability and DTR of the model can be improved with model iterations. First, at the 600th iteration, the reliability of the traditional and optimized models is improved to 0.65 and 0.70, respectively. Second, at the 600th iteration, the DTR of the traditional model and the optimized model can reach 0.7 and 0.82. Thus, the optimized model’s DTR has been improved by 0.12 to the traditional model. The research results show that number of music ICH performing groups, the number of people performing on-site, the variety, and the attractiveness of the tourist music market are 0.791, 0.862, 0.806, and 0.754, respectively. The
optimized music ICH brand equity evaluation model has excellent performance. It can meet the needs to recognize and classify music ICH and integrate music ICH with the tourism industry.

In summation, this work studies video scene recognition and feature extraction of music ICH and proposes the DBN-based music ICH brand equity evaluation model through signal processing and brand building. The results show that at the beginning, the pattern recognition accuracy of the traditional model is only 67.5%. Then, the recognition accuracy of the traditional model can reach 72.5% at the 500th iteration. In contrast, the average recognition accuracy of the improved model can reach 80%, and the highest can reach 82.5%. Therefore, traditional music is a precious cultural heritage. Today, it still has great dissemination and utilization value. Inheriting traditional music is actually to protect and spread the unique charm of traditional music. In this process, there is a need to integrate the elements of modern pop music. Relative departments must endow traditional music with cultural connotations and strengthen the protection of traditional music ICH. Meanwhile, effective measures should be explored from multiple perspectives, especially reasonable application methods, to provide funds for the inheritors of nontraditional music.

**Figure 6:** Curve of model recognition recall rate and F1-value with the increase of experimental iterations. (a) Recall rate; (b) F1-value.

**Figure 7:** Comparison of the model reliability and the DTR with the increase of model iterations. (a) Reliability; (b) DTR.
ICH. Funds for traditional and endangered music must be offered, and professionals should be organized to carry out project-related works. At the same time, the ICH inheritors can be encouraged to restore ICH. Excellent traditional music can enter communities, schools, and urban and rural activities by creating conditions. Ultimately, these actions and measures can improve the creative enthusiasm of the inheritors, expand the enthusiasm of the masses to participate in music education, and improve the inheritance and protection effect of music ICH.

5. Conclusion

The contribution of this work is to introduce the brand-building process of music ICH based on the IoT, information technology, and the integration of cultural tourism development. Music content’s video detection and feature extraction are studied through the recognition and processing of music signals. This work puts forward the organic integration mechanism of music ICH and the tourism industry. The results show that the recognition accuracy and precision of the model are greatly improved after the iterative optimization. The average accuracy of the model recognition of the improved model can reach 80%, and the highest accuracy is 82.5%. Additionally, at the 600th iteration, the recall of the traditional and optimized models can reach 75% and 85%, respectively. The main innovation is that it puts forward the integration mechanism model of the smart city tourism industry and music ICH. Therefore, the brand equity evaluation model of the music ICH proposed here has excellent performance. It can meet the needs of the tourism industry integrated with music ICH in smart cities. Finally, some deficiencies in the study need to be improved. In processing music and video signals of music ICH, the data signals optimization and filtering model need further optimization. Future research will extract more music ICH data, iterate, and optimize the model, enhance the recognition accuracy and precision, and improve the recognition effect of the model.

Data Availability

The data used to support the findings of this study are included within the article.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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