Research Article
Digital Protection and Development of Intangible Cultural Heritage Relying on High-Performance Computing

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Received 28 January 2022; Accepted 17 March 2022; Published 13 April 2022
Academic Editor: Daqing Gong
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The protection of intangible cultural heritage has gradually attracted people’s attention. In today’s digital information age, the use of digital technology in the protection of intangible cultural heritage has become the focus of research in the field of intangible cultural heritage protection. For the protection of intangible cultural heritage to become the key goal of the continuous inheritance of China’s traditional culture, this paper fully analyzes the problems existing in the inheritance and protection of intangible cultural heritage, and applies the high-performance computing method to the digital protection and development of intangible cultural heritage, which provides a strong basis for the protection of intangible cultural heritage. The accurate identification and protection of intangible cultural heritage can be achieved by using high-performance computing methods. In addition, the digital protection and development system of intangible cultural heritage is also designed. Finally, the example results show that the digital protection and development system of intangible cultural heritage proposed in this paper can effectively protect intangible cultural heritage and promote the continuous development of domestic local economy. At the same time, it can also strengthen the public awareness of the protection of intangible cultural heritage and effectively promote the inheritance and development of the protection of intangible cultural heritage.

1. Introduction
China’s intangible cultural heritage has rich cultural connotation and cultural heritage value. In the process of continuous excavation, it can reproduce historical events and development tracks. Meanwhile, intangible cultural heritage also carries Chinese traditional cultural beliefs and inherits historical culture in a variety of ways, carries the historical culture with diversity and flexible development as a long-term development system of Chinese civilization. It can reflect the value of national tradition, cultural value and aesthetic value. The protection and inheritance of intangible cultural heritage are inherent spiritual needs of human beings [1–3]. However, the aesthetic status of intangible cultural heritage deserves further consideration, which is confirmed in the In terms of the continuous development of society, the continuous economic growth, the inheritance of traditional culture and the awareness of cultural values, and can be carried out in the protection and development of traditional intangible cultural relics, and the electronic archives of intangible cultural heritage is established and other multi-channel protection methods are utilized to protect and develop the traditional intangible cultural heritage [4–6]. With the continuous progress of society, in the process of development and protection of intangible cultural heritage, digital protection will become the goal of in-depth research and exploration by Chinese and foreign scholars. The digital technology is used to electronically archive intangible cultural heritage, not only effectively processing massive data, be conducive to data storage and query, but also effectively avoid the loss and damage of data and information caused by natural and man-made disasters [7, 8]. The data mining technology can be used to deeply analyse the stored intangible cultural heritage data, provide valuable information data for visitors or users, and then complete the exchange and application of culture around the world. the high-performance computing and identification can be performed for the intangible cultural heritage as one of the most popular types of visual aggregation, which has become the focus of Chinese scholars’ research [9–11].
However, how to obtain specific content sources from the initial intangible cultural heritage data that lacks the definition of intangible cultural heritage content has become a huge challenge for current high-performance computing. Intangible cultural heritage follows the way of time-sorting, which can use the high-performance computing in accordance with its stealth. At present, other classification methods are relatively simple, and the characteristics of intangible cultural heritage are not accurate.

This paper proposes the digital protection and development of intangible cultural heritage. This method uses high-performance computing methods to extract the characteristics of intangible cultural heritage, calculate the weight of its protection space, integrate the space with high similarity in meaning, and build an intangible cultural heritage protection and development model. Intangible cultural heritage preserves cultural integrity through digitization, which is different from traditional cultural expressions and forms, because it is not a physical existence, but an information exchange across regions and countries. It covers scientific culture, social environment, civilized science and other cultures.

2. Technologies and Methods

2.1. High-Performance Computing Methods. The high-performance computing system can realize the I/O operation of the hard disk as little as possible based on the memory computing technology, and can also perform operation data analysis in the memory. Hadoop’s MapReduce calculation engine saves the calculated intermediate value in the memory. In the next calculation, the original I/O request must be stored externally. Since high-performance computing directly stores intermediate values in memory and repeats them, high-performance computing reduces the time of data transmission as a whole compared with previous MapReduce, thereby ensuring the work efficiency of tasks [12, 13].

In view of the accuracy and diversity characteristics of intangible cultural heritage based on high-performance computing algorithms, the comprehensive analysis standard representation of data based on high-performance computing algorithms is defined, including

$$E_{\text{val}}(\pi_p) = \lambda A_{\text{cu}}(\pi_p) + (1 - \lambda)D_{\text{iv}}(\pi_p).$$  \((1)\)

In the formula $\lambda \in [0, 1]$, the correctness and diversity of data processing are important degrees in the comprehensive analysis standard.

Formula (1) calculates the probability $\text{pro}(\pi_p)$ that each data basic processing algorithm is selected as the analysis basic processing based on the diversity $\text{Div}(\pi_p)$ of the basic processing of the high-performance computing algorithm. The calculation formula is as follows.

$$\text{pro}(\pi_p) = \frac{\text{Div}(\pi_p)}{\sum_{p=1}^{B} \text{Div}(\pi_p)}.$$  \((2)\)

The purpose of the data processing network module is to make the color and spatial position of each reconstructed data to restore the inherent color and texture of the data. The loss function $\text{Lip}$ of the data processing network module is defined by the formula. The above shown are processing loss for unmasked regions, processing loss for masked regions, perceptual loss, style loss, antiloss, and total difference loss.

$$L_{\text{valid}}^\text{inp} = 2L_{\text{valid}} + 12L_{\text{hole}} + 0.04L_{\text{per}} + 100(L_1^{\text{style}} + L_2^{\text{style}})$$

$$+ 100L_d d + 0.3L_{\text{var}}.$$  \((3)\)

The weight of each loss item is determined by analyzing the results of 50 independent experiments.

The weight of each loss item is determined by analyzing the results of 50 independent experiments. Manhattan distance uses the unmasked region of both the processed mode and the real mode to process the loss. In the equation, $I_{\text{dam}}$ is the damage mode, $I$ is an irregular binary mask (the corresponding processing area in the mask is 0, the others are 1), and $I_{\text{inp}}$ is the processing result mode. $I_{\text{real}}$ actually indicates there is no damage mode. The processing loss function for masked regions is similar to the expression:

$$L_{\text{valid}}^\text{inp} - \|M \times (L_{\text{inp}} - I_{\text{dam}})\|_1,$$  \((4)\)

High-performance computing algorithms dynamically adjust appropriate parameter values based on the identification complexity of different regions of the data, so that the high-performance computing algorithm maintains a constant speed, and the generated metadata is more neatly unified in subsequent processing. In order to reduce the impact of the difference in the shape of the super data on the algorithm, this parameter does not need to be specified. Compare the $I_{\text{real}}$ reduction identification points of intangible cultural heritage, $h$ is the junction point of the first data, which is located in the data corresponding to the intangible cultural heritage database. $0 \leq k \leq h(vx_{2k+1,j}, vy_{2k+1,j})$, the following mining operations are performed on all identification points:

$$\begin{aligned}
\text{dx}^i_k &= vx_{2k+1,j} - vx_{k,j} \\
\text{dy}^i_k &= vy_{2k+1,j} - vy_{k,j},
\end{aligned}$$

$$\begin{aligned}
vx_{2k+1,j} &= \left[ vx_{k,j} \right] + \left[ \cos(-\theta) -\sin(-\theta) \right] \times \left[ \text{dx}^i_k \right] \\
vy_{2k+1,j} &= \left[ vy_{k,j} \right] + \left[ \sin(-\theta) \cos(-\theta) \right] \times \left[ \text{dy}^i_k \right],
\end{aligned}$$  \((5)\)

For each piece of data $P_i$ and $\bar{P}_i$, calculate the barycentric coordinates after removing the last point:

$$\begin{aligned}
\overline{vx}_{k,j} &= \frac{1}{k - 1} \sum_{k=1}^{k-1} vx_{k,j} \\
\overline{vy}_{k,j} &= \frac{1}{k - 1} \sum_{k=1}^{k-1} vy_{k,j},
\end{aligned}$$

$$\begin{aligned}
\overline{vx}_{k,j} &= \frac{1}{k - 1} \sum_{k=1}^{k-1} vx_{k,j} \\
\overline{vy}_{k,j} &= \frac{1}{k - 1} \sum_{k=1}^{k-1} vy_{k,j}.
\end{aligned}$$  \((6)\)
In the formula, \( h \) is the length (number of nodes) of the i-th piece of data after the intangible cultural heritage database is divided; the \( h' \) data is embedded in the identified length, and the following two offset values are calculated:

\[
\begin{align*}
\Delta x_i = & \frac{1}{2h_i - 2} \sum_{k=1}^{k_i-1} (v_{x_{k+1}} - v_{x_k}) p_k, \\
\Delta y_i = & \frac{1}{2h_i - 2} \sum_{k=1}^{k_i-1} (v_{y_{k+1}} - v_{y_k}) p_k,
\end{align*}
\]

(7)

According to formula (12) to formula (15), calculate the identification point of the vertical and horizontal coordinates of each piece of data respectively.

1. \( \Delta x_i \neq 0, \Delta y_i \neq 0 \)

\[
\begin{align*}
q_x_j = & \sum_{\{i| i \neq j\}} \frac{v_{x_j} - v_{x_i}}{\Delta x_i} = \sum_{\{i| i \neq j\}} \bar{b}_j \alpha = c\bar{b}_j \alpha, \\
q_y_j = & \sum_{\{i| i \neq j\}} \frac{v_{y_j} - v_{y_i}}{\Delta y_i} = \sum_{\{i| i \neq j\}} \bar{b}_j \alpha = c\bar{b}_j \alpha.
\end{align*}
\]

(8)

2. \( \Delta x_i = 0, \Delta y_i \neq 0 \)

\[
\begin{align*}
q_x_j = & \sum_{\{i| i \neq j\}} \frac{v_{x_{k+1}} - v_{x_k}}{\Delta x_i} = \sum_{\{i| i \neq j\}} \bar{b}_j \alpha = c\bar{b}_j \alpha, \\
q_y_j = & \sum_{\{i| i \neq j\}} \frac{v_{y_{k+1}} - v_{y_k}}{\Delta y_i} = \sum_{\{i| i \neq j\}} \bar{b}_j \alpha = c\bar{b}_j \alpha.
\end{align*}
\]

(9)

3. \( \Delta x_i \neq 0, \Delta y_i = 0 \)

\[
\begin{align*}
q_x_j = & \sum_{\{i| i \neq j\}} \frac{v_{x_{k+1}} - v_{x_k}}{\Delta x_i} = \sum_{\{i| i \neq j\}} \bar{b}_j \alpha = c\bar{b}_j \alpha, \\
q_y_j = & \sum_{\{i| i \neq j\}} \frac{v_{y_{k+1}} - v_{y_k}}{\Delta y_i} = \sum_{\{i| i \neq j\}} \bar{b}_j \alpha = c\bar{b}_j \alpha.
\end{align*}
\]

(10)

4. \( \Delta x_i = 0, \Delta y_i = 0 \)

\[
\begin{align*}
q_x_j = & \sum_{\{i| i \neq j\}} \frac{v_{x_{k+1}} - v_{x_k}}{\Delta x_i} = \sum_{\{i| i \neq j\}} \bar{b}_j \alpha = c\bar{b}_j \alpha, \\
q_y_j = & \sum_{\{i| i \neq j\}} \frac{v_{y_{k+1}} - v_{y_k}}{\Delta y_i} = \sum_{\{i| i \neq j\}} \bar{b}_j \alpha = c\bar{b}_j \alpha.
\end{align*}
\]

(11)

After extracting the cultural information, check the authenticity of the identification. This process uses the correlation coefficient \( \text{cor} \) to detect the similarity between the original recognition and the extraction recognition:

\[
\text{cor} (m, \tilde{m}) = \frac{\sum_{i=0}^{m-1} (m_i \tilde{m}_i)}{\sqrt{\sum_{i=0}^{m-1} m_i^2 \sqrt{\sum_{i=0}^{m-1} \tilde{m}_i^2}}}
\]

(13)

In the formula, \( \tilde{m} \) is the cultural information extracted from the identified graphics; \( \text{cor} (m, \tilde{m}) \) is the correlation coefficient of the cultural information \( m \) and \( \tilde{m} \). When high-performance computing optimizes the BP algorithm, the roulette method is usually chosen. If the fitness of the i-th individual is \( f_i \), the probability \( P_{si} \) of the i-th individual being left behind is

\[
P_{si} = \frac{f_i}{\sum_{j=1}^{n} f_j}
\]

(14)

In this paper, as shown in (9), an overall crossover scheme is chosen.

\[
\alpha = \begin{cases} 
\frac{f_{\text{max}} - f_i}{f_{\text{avg}} - f_{\text{max}}}, & f_i \geq f_{\text{avg}} \\
0.35, & f_i < f_{\text{avg}}
\end{cases}
\]

(15)

In the formula, \( \alpha \) represents the gene-encoded combination coefficient, \( f_i \) represents the fitness value of the i-th individual in the parent population, \( f_{\text{max}} \) and \( f_{\text{avg}} \) represent the maximum and average fitness values of the individuals in the parent population, respectively.

The final high-performance computing process is shown in Figure 1.

Effectively combining the compatibility of high-performance computing with more distributed systems, the main operating modes of the system can be divided into single-point mode and dispersion mode. This mode mainly uses YARN, Mesos or EC2 for resource allocation and scheduling. RDD is computed by using high-performance computing, and the memory with prominent operation characteristics can effectively improve the calculation efficiency of the model. RDD has the data characteristics of compatibility and parallelism, and can interact with the memory and external memory. If the storage cannot meet the requirements of a single RDD, the RDD will be transferred to the external memory. The digital protection and development algorithm can obtain better performance in the process of data mining. This algorithm can be used for training data to reduce the accuracy and performance. In order to solve this problem, the data mining method is used to directly determine the
The output of each unit of the learning sample input
Weight and threshold initialization
Hidden layer output layer assignment
The output of each unit of the output layer
Error solving
Inverse Generalization Error Calculation
Adjustment of weights and thresholds between layers

**Figure 1:** High-performance computing flow chart.

first category as the final data. As a result, the tie situation that cannot be solved by the average value cannot be fundamentally solved, so the drawbacks of the model can be effectively avoided. The classification performance of each classifier is protected using the Berius equation. The formulas that can be used are:

\[
\text{weight}(i) = 1 - \frac{1/con(i)}{\sum_{j=1}^{T} 1/con(j)} \cdot \frac{N}{N - 2}
\]  
(16)

In formula (1), N represents the total number of classifiers, con(k) represents the posterior probability of the classification result of the kth classifier in the Bagging algorithm, and weight(i) represents the weight of the i-th classifier.

Two properties of the formula:

1. The higher the classification accuracy rate, the higher the weight of the high-performance computing
2. Conform to the formula \(\sum_{j=1}^{T} \text{weight}(i) = 1\), that is, all high-performance computing can meet the normalization conditions

The Bagging algorithm can be analyzed through out-of-bag data. The F1 value of out-of-bag is smaller than the Bayes formula according to the calculated verification probability. Therefore, in order to reduce the amount of calculation and give up the post-probability of the classification result, the F1 of Out-of-bag is used to judge the correctness of the classification. You can obtain formula (12) by modifying formula (11):

\[
\text{weight}(i) = \frac{2}{N} \cdot \frac{1/\text{oob}F_1(i)}{\sum_{j=1}^{T} 1/\text{oob}F_1(j)}
\]  
(17)

In formula (2), N represents the total number of classifiers, \(\text{oob}F_1(k)\) represents the F1 value of the out-of-bag of the kth classifier, and weight(i) represents the weight of the i-th classifier.

From the perspective of industrial connections, the collection of enterprises generally appears as a vertical chain connection, upstream and downstream enterprises are effectively linked through production links, and the cooperation and competition relationship is the center between enterprises. The SDA method assumes that n sample sets X are processed:

\[X = \{x_1, x_2, \ldots, x_n\}\]  
(18)

The index used is p, and fuzzy clustering is performed according to the classification:

\[x_k = \{x_{k1}, x_{k2}, \ldots, x_{kp}\}, x_{kj} = [a_{kj}, b_{kj}], 1 \leq k \leq n, 1 \leq j \leq p\]  
(19)

The relative membership degree of the matrix of the model is represented by U:

\[U = \{u_{ik}\}, (i = 1, 2, \ldots, c; k = 1, 2, \ldots, n)\]  
(20)

\(u_{ik}\) indicates the membership degree of sample point k to category i, and satisfies the following conditions.

\[
\begin{align*}
\sum_{i=1}^{c} u_{ik} &= 1, \forall k, \\
0 &\leq u_{ik} \leq 1, \forall k, i.
\end{align*}
\]  
(21)

The cluster center of the i-th category can be represented by \(g_i\):

\[g_i = (g_{i1}, g_{i2}, \ldots, g_{ip}), g_{ij} = [a_{ij}, b_{ij}], 1 \leq i \leq c, 1 \leq j \leq p\]  
(22)

Here, the weight of the cluster is expressed by importing the adaptive parameter \(\lambda\):

\[\lambda_k = (\lambda_{k1}, \lambda_{k2}, \ldots, \lambda_{kp})\]  
(23)

The expression of comprehensive weight is

\[
W = \sum_{i=1}^{n} \sum_{i=1}^{m} (u_{ik})^2 \Phi(x_{ki}, g_{i}) = \sum_{i=1}^{c} \sum_{i=1}^{n} (u_{ik})^2 \left\{ \sum_{j=1}^{p} \lambda_{kj} \left( \frac{a_{kj} + b_{kj}}{2} - \frac{a_{kj} - b_{kj}}{2} \right) \right\},
\]  
(24)

which satisfies

\[
\begin{align*}
\lambda_{ij} &\geq 0, \\
\prod_{j=1}^{p} \lambda_{ij} &= 1.
\end{align*}
\]  
(25)

The Lagrangian method is used to derive the aggregation function to obtain
generally speaking, the effect of enterprise concentration mainly comes from various factors such as natural resources, geographical environment and process technology. The initial integration mainly reflects the production and operation cooperation between different enterprises. Geographical location integration among enterprises is essentially based on competitive and cooperative relations, and the clustered enterprise matching degree is used for integrating internal resources of the enterprise, reducing trade costs as much as possible, and maximizing profits at the same time.

High-performance computing can build the most serialized time series models and use them on a large scale in the process of digital protection and development of intangible cultural heritage. The N states existing in the model can be set possible, and maximizing profits at the same time.

For some samples, any state can reach other states in one transition; other samples, in other samples, only transitions to cultural heritage. kZ_he N states existing in the model can be set possible, and maximizing profits at the same time.

Therefore, the samples can be summarized into three groups \( \lambda = (A, B, \pi) \). Then the observation sequence generated by this model can be expressed as \( O = o_1 o_2 \cdots o_n \), \( o_t \) represents the vector that can be observed at time \( t \), and \( T \) represents the total observation length.

### 2.1.1. Digital Protection and Exploitation
The time complexity and space complexity of high-performance computing of intangible cultural heritage are mainly affected by the dimension of the feature vector of intangible cultural heritage. In order to effectively improve the protection accuracy of the constructed model, the extraction of the model space can be determined by reducing the dimension of the intangible cultural heritage. In this paper, the information gain algorithm is used to calculate the average amount of information of the constructed model:

\[
G(w) = - \sum_{k=1}^{N} P(c^k) \log_2 P(c^k) + P(w) \sum_{k=1}^{N} P(c^k | w) \log_2 P(c^k | w) + P(\overline{w}) \sum_{k=1}^{N} P(c^k | \overline{w}) \log_2 P(c^k | \overline{w}).
\]

In the formula, represents the complementary set of \( w \). \( w_0 \) corresponds to the number of spaces \( T \): the average number of heritages in the intangible cultural heritage is trained. In the preprocessing stage, the preprocessed intangible cultural heritage is represented by word2 vec as a vector, and the intangible cultural heritage vectors with high similarity are combined to record the number of heritages. During the process of space selection in this paper, the meaning information of spatial agglomeration vectors is considered. For built HPC, the space is traversed during state transitions. The sequence of the spatial output is expressed as using \( k \), and \( k \) is expressed as the spatial sum that meets the similarity threshold. Therefore, in obtaining the intermediate state \( s_i \) of this model, the corresponding observation value distribution in the class \( c^k \) can be expressed as

\[
b^i_{c_k}(w_c) = P(k|s_i = w_c).
\]

Taking into account that the distribution of \( b^i_{c_k} \) and spatial frequency is constrained, with the increase of spatial
distance in the whole processing process, the aggregation of different intangible cultural heritage will also be lower.

\[ b_{ik} (w_c) = IFI \frac{D_k(i) + 1}{\sum_k D_k(i) + |C|} \times \frac{N^k(i) + 1}{\sum_k N^k(i) + |C|} \] (33)

In the formula, \( D_k(i) \) represents the intangible cultural heritage business items containing \( w_c \) in \( c_k \); \( N^k(i) \) represents the number of occurrences of space \( w_c \) in the \( c_k \) category, then the number of occurrences in the same category will have The role of regularization.

For the state transition matrix, due to the high-performance computing of \( c_k \), it can be summarized as the intangible cultural heritage in this category, then it will be transferred from the first state to the second stage state until the end of the state. The matrix of state transition \( \mathbf{A}^c \) can be expressed as

\[ a_{ij} = \begin{cases} 1, j = i + 1, \\ 0, j \neq i + 1. \end{cases} \] (34)

Specify the probability \( \pi = \{1, 0, \cdots \} \) of the initial state \( s_0 \). High performance computing for the category \( c_k \) can be expressed as

\[ \lambda_k = \{\Pi, A_{c_k}, B_{c_k}\}. \] (35)

2.1.2. Digital Protection and Development of Intangible Cultural Heritage. Because of the randomness of the collected data and the splitting of the node characteristics, it can ensure that there is no connection between the obtained deterministic numbers, and meanwhile, it can be used for the visual aggregation method of scientific computing, so that it has the characteristics of initial parallelism. Digital protection and development algorithms can effectively provide feedback on decision parallelization, node parallelization, and feature selection.

The scientific computing visualization aggregation method is used to parallelize the collected data, which can realize the method of dispersing multiple computer nodes for the sample data during the operation. Compared with the traditional single machine identification method, it can effectively save I/O operations, and can reduce the use of more network bandwidth. According to the data obtained by parallel computing, the idea of parallelization of scientific computing visualization aggregation method is used in this paper, and combining the framework characteristics of high-performance computing, a parallel implementation strategy for scientific computing visualization aggregation is designed.

(1) Sample Sampling Statistics of Feature Cut Points. According to the optimal feature of the decision tree that needs to be determined, the cut point is selected for the selected feature, and the distribution feature of the data is used to sample and analyse different data features, and finally summarize to the master node of the data. This operation is mainly to perform the whole process of computation based on different node pairs, but only a smaller bandwidth is used in the final stage of integration. Therefore, for the value of the entire eigenvalue of the data, during the process of sorting the data, the use of larger bandwidth and I/O operations should be avoided as much as possible. The method of data collection will have a direct impact on the accuracy of the data.

(2) Layer-By-Layer Training of Data Samples. The deep optimization of high-performance computing in a single-sample mode is transformed into a priority strategy as the essence of each layer of training. In a distributed environment, in order to realize the training of each layer, the number of different loops that need to be constructed is the same as the maximum layer of the tree. In addition, during the loop stage, it is necessary to perform parameter statistics and judge on the split points of nonleaf nodes, according to the characteristics.

It is necessary to initialize the RFM parameters, and then use the Baum-Welch algorithm to perform operations. According to the use of the scientific computing visualization aggregation algorithm, the results obtained have a great relationship with the initial parameters. The transformation matrix needs to be initialized to determine whether the transition matrix is 0 or that after the iterative operation is 0. Define the observation sequence as

\[ P(O|\lambda) \geq P(O|\lambda). \] (36)

The way to compute \( P(O|\lambda) \) is a forward-backward algorithm. For the sample parameter \( \lambda \) and state \( i \), define the forward probability \( a_i (i) \):

\[ a_i (i) = P(o_1, o_2, \cdots, o_T | q_t = i, \lambda). \] (37)

That is, \( a_i (i) \) is the probability that the parameter \( \lambda \) produces the sequence \( (o_1, o_2, \cdots, o_T) \) and the state at time \( t \) is \( o_t \). \( P(O|\lambda) \) can be calculated by the following forward algorithm.

(1) Initialization

\[ a_i (j) = b_j (a_i), 1 \leq j \leq N. \] (38)

(2) Recursion

\[ a_i (i) = b_i (a_i) \sum_{j=1}^{N} a_{i-1} (j) a_{ji}, 2 \leq t \leq T, 1 \leq i \leq N. \] (39)

(3) Termination

\[ P(O|\lambda) = \sum_{j=1}^{N} a_T (j). \] (40)

Define both \( \beta_i (i) \) and \( \xi_i (i, j) \)

\[ \beta_i (i) = P(o_{t+1}, o_{t+2}, \cdots, o_T | q_t = i, \lambda), \]

\[ \xi_i (i, j) = P(q_T = i, q_T + 1 = j| O, \lambda). \] (41)

From the forward-backward calculation method, \( \xi_i (i, j) \) can also be expressed as [11, 12]:

\[ \begin{align*}
    \beta_i (i) = & \sum_{j=1}^{N} a_j (j) a_{ji} \\
    \xi_i (i, j) = & \sum_{k=1}^{N} a_j (k) a_{ki} a_{k}\end{align*} \]
Table 1: Experimental environment parameters.

| Development program | Version |
|---------------------|---------|
| Operating system    | CentOS 7.3 |
| JDK                 | 1.8.0–144 |
| Internet            | 2 GB    |
| Hadoop              | 2.7.0   |
| High-performance computing | 2.12.4 |
| Master node         | 4 cores, hard disk 256G, 8G memory, one node |
| Worker node         | 1 core, 250G hard disk, 2G memory, five nodes |

\[
\xi_{i,j} = \frac{P(q_i = i, q_{i+1} = j | \lambda \theta)}{P(O|\lambda)} = \frac{\alpha_i(i)\alpha_j(j)\beta_{i+1}(j)}{\sum_{j=1}^{N} \alpha_j(j)\beta_{i+1}(j)}
\]

The probability \( \gamma_{i,m} \) that the system is in the \( m \)-th mixed component of state \( i \) at time \( t \) is:

\[
\gamma_{i,m} = \frac{\alpha_i(i)\beta_{i}(i)\mu_{j,m}N(\alpha_{i},\mu_{j,m},\Sigma_{j,m})}{\sum_{i=1}^{N} \alpha_i(i)\beta_{i}(i)\sum_{m=1}^{M} \omega_{j,m}N(\alpha_{i},\mu_{j,m},\Sigma_{j,m})}
\]

First, the labeled training set is used to train samples of various classes, respectively. Let the class that requires high-performance computing be \( k = \{1, 2, \ldots, K\} \), and each class corresponds to the model parameters \( \lambda_k \). The maximum likelihood criterion is used to maximize the posterior probability, while considering the Bayes formula, then:

\[
\bar{k} = \arg \max_{1 \leq k \leq K} P(\lambda_k | O) = \arg \max_{1 \leq k \leq K} \frac{P(O | \lambda_k)P(\lambda_k)}{P(O)}
\]

Assuming that the prior probability \( P(\lambda_k) \) of each type is the same, because \( P(O) \) and \( k \) are not related, the decision is omitted as follows:

\[
\bar{k} = \arg \max_{1 \leq k \leq K} P(O | \lambda_k).
\]

Because \( P(O | \lambda_k) \) is very small, floating-point underflow will occur during computer operations, so logarithmic values are usually taken from it. For multiple observation sequences, only each formula needs to be weighted [14].

In the current intangible cultural heritage space identification industry, in order to meet the different needs of enterprises, \( i \) the individual needs of enterprises need to be responded to in a timely manner, and the intangible cultural heritage is mainly divided into two parts: development and design. On the basis of fully analyzing the changes in market demand, personalized services can be provided to enterprises in terms of the development process and design cycle of emerging intangible cultural heritage; meanwhile, personalized design of intangible cultural heritage can be carried out according to the actual needs of enterprises. The goals of these two links are not the same as the main tasks, but there is an internal connection. In the process of intangible cultural heritage space identification, modular and standardized design is carried out as the basis for the intangible cultural heritage space identification process. Regarding the nonsegmented pieces of clothing in the process of intangible cultural heritage space identification, it should be transformed into a provincial virtual reality model, and it should include knowledge to support the development of new intangible cultural heritage and knowledge of corporate design according to corporate needs.

High-performance computing, which is based on virtual reality, “enhances” the real world by superimposing computer-generated virtual objects, scenes or system cues on the actual scene. High-performance computing can not only introduce virtual objects into the actual environment, but also dynamically show the position and posture of virtual objects to maintain the consistency of virtual objects and actual scenes, therefore the habit of observing high-performance computing environments with more personal eyes can be cultivated. This way of interaction looks more natural. On the other hand, since HPC keeps the actual scene, the output is more realistic [15–17].

If the high-performance computing is used, the cameras can be used to capture real-world situations to obtain video streams. The tracking method is used to process each frame in the video stream, the actual coordinates and state of the camera are calculated using geometric calculation methods, and the coordinates and states of the virtual objects registered in the actual background are used to form a virtual scene. The technology of video combination is used, to combine the virtual scene and the real background video stream are combined, and the combined result is transmitted to the display in time.

3. Experimental Results and Analysis

Each parallel frame in this experiment is constructed in the environment of high-performance computing cluster, the storage in the experiment is carried out by Hadoop, and the calculation of the data in the experiment is presided over by the high-performance computing program. The various development programs and their version numbers used in this experiment are shown in Table 1.

In order to verify the institutional hypothesis in the previous sentence, the verification model is set as follows.

\[
\text{ITU}_{s_{ijk}} = \alpha + \beta_1 f \text{incol}_{ijkt} + \beta_2 X_{ijkt} + \theta_i + r_j + \phi_t + \epsilon_{ijk}.
\]

In the formula, \( k, i, j, \) and \( t \) respectively represent the enterprise, industry, region and year; \( \text{ITU}_{s_{ijk}} \) represents the transformation result of manufacturing enterprises;
The spatial synergistic distribution between intangible cultural heritage and manufacturing; $X_{ijk}$ represents the control variable; $\alpha$ represents the constant term; $\epsilon_{ijk}$ is the random disturbance term. In addition, industry fixed effects $\theta_i$, region fixed effects $\tau_j$, and time fixed effects $\phi_t$ are added to the model.

The above combines the mathematical relationships between all attributes to validate the resulting attributes.
obtained from the results of the classification model and evaluate the model performance against the metrics of the confusion matrix. Table 2 is the confusion matrix.

The experimental results are shown in Table 3. The experimental results show that the comparison of the accuracy of the protection of intangible cultural heritage is achieved by using the two algorithms to compare the experiments. Experiments also fully demonstrate the reliability of this method.

Figure 2 is an interface diagram of the AR module and the VR module. The module is introduced, and the interactive functions of video, voice, and intangible cultural heritage introduction are added. The origin of traditional cultural works, the production technology and development are described. Figure 3 is the effect of voice and text explanation. The VR module provides a detailed display function of VR 3D models. Users can enter the display page of VR 3D models of traditional cultural works by clicking the photos of traditional cultural works Save the model screen of interest. The AR module strengthens the relevant information of traditional cultural works through user scanning, and meanwhile paints for design on the traditional cultural works card, which enhances the interest and interaction of AR experience. This is to strengthen the display effect of the mobile terminal before and after the card is painted. In the feedback module, users can give feedback on the usage of the APP. Further enrich the functions of the APP to meet the needs of users.

In addition, the postcard design method using AR still contains traditional culture. In order to further protect the inheritance of intangible culture, the AR Postcard designed with traditional design methods according to Figure 4 can understand the traditional culture from the designed postcard. As an effective carrier of culture, the postcard can further improve the inheritance of intangible cultural inheritance, Users can use the mobile terminal to query and design ar postcards containing traditional cultural works. AR postcards enhance the display of reality. Traditional handicrafts combine modern digital and interactive media technology to attract the younger generation to understand the production process and aesthetic characteristics of traditional handicrafts.

It is held to further publicize and popularize the protection of intangible cultural heritage. Traditional cultural works enter campus activities. Through activities in kindergartens, primary schools and other places around the city, the origin and manufacturing technology of traditional cultural works are displayed in 3D models of traditional cultural works. The mobile augmented reality APP test designed in this paper stimulates enthusiasm for learning from students and teachers to understand the intangible cultural heritage. Compared with the traditional intangible cultural protection method, this system improves the user’s sense of experience and mutuality (Figure 5).

4. Conclusion

In the process of the development of modern society, human’s sense of inferiority towards traditional culture is not only the preservation, recording and display of cultural
attributes, but also human’s respect for their own cultural history and the continuation of life system. This paper uses digital technology to build a three-dimensional space, divide, organize and reshape the intangible cultural heritage, and store the processed intangible cultural heritage according to the three-dimensional dynamic mode, so as to build a multimedia data platform in the intangible cultural heritage protection system. Using this platform can make the public have a more comprehensive understanding of intangible cultural heritage. Promote the inheritance of China’s intangible cultural heritage. The analysis of the experimental results shows that: using digital technology to classify and sort out the intangible cultural heritage project resources in China, and establish a systematic and comprehensive digital archives; the benefits of protection and inheritance are becoming more and more obvious. Whether the digital protection using modern science and technology or the field records of Anthropology and sociology have positive practical significance and value for the inheritance and development of intangible cultural heritage.

Data Availability

The data used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no conflicts of interest.

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