Hindawi
Security and Communication Networks
Volume 2023, Article ID 9895359, 1 page
https://doi.org/10.1155/2023/9895359

Retraction

Retracted: Digital Protection Technology of Cultural Heritage Based on ArcGIS Geographic Information Technology Algorithm

Security and Communication Networks

Received 27 June 2023; Accepted 27 June 2023; Published 28 June 2023

This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

References

[1] X. Guo, W. Jiang, Q. Zhang, and K. Wang, "Digital Protection Technology of Cultural Heritage Based on ArcGIS Geographic Information Technology Algorithm," *Security and Communication Networks*, vol. 2022, Article ID 3844626, 10 pages, 2022.

Hindawi
Security and Communication Networks
Volume 2022, Article ID 3844626, 10 pages
https://doi.org/10.1155/2022/3844626

Research Article

Digital Protection Technology of Cultural Heritage Based on ArcGIS Geographic Information Technology Algorithm

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Received 29 December 2021; Revised 24 January 2022; Accepted 28 January 2022; Published 7 March 2022

Academic Editor: Chin-Ling Chen

In order to improve the effect of digital protection of cultural heritage, this paper analyzes the spatial and temporal characteristics of cultural heritage with the support of ArcGIS technology, conducts research on ArcGIS' geographic information technology algorithm, and improves the algorithm with the support of digital technology. Moreover, this paper combines the watermark algorithm to digitally mark cultural heritage to improve the copyright effect of cultural heritage. In addition, this paper proposes a topological integrity verification method based on weak watermark vector geographic data to improve the reliability of digital processing of cultural heritage, and build an intelligent cultural heritage digital protection system model. The research results show that digital protection technology of cultural heritage based on the ArcGIS geographic information technology algorithm in this paper can play an important role in the digital protection of cultural heritage.

1. Introduction

With the rapid progress and renewal of social productivity and production methods, global economic models, values, and thinking models are all close to convergence, and the traditional culture, beliefs, living habits, and concepts belonging to their respective countries and nations are gradually being ignored. Looking back at the domestic situation as well, the past few decades have been an era of rapid economic development. However, in the process of economic development, the protection of and attention to the country and national culture have been neglected, and many precious national treasures, cultural and traditional skills, etc., have been destroyed or even disappeared. Due to the continuous expansion and development of urban land, the traditional rural culture based on farming civilization has been swallowed or shrunk. The mismatch between traditional cultural heritage and modern life and functions has caused a crisis of protection and inheritance. As a result, the reflection of opposing cultural convergence and protecting regional culture has become a new social demand of domestic and foreign governments and scholars, and has stimulated the exploration and maintenance of their own national and regional cultural activities.

Intangible cultural heritage tourism has become an important way for tourists to understand Chinese history, culture, and folk customs. At the same time, the impact of intangible cultural heritage tourism on heritage sites has also attracted widespread attention from all sectors of society. As the contradiction between intangible cultural heritage protection and tourism development continues to sharpen, the demands of relevant stakeholders cannot be met, and the quality of tourist experience is affected. In the process of its integration with tourism, problems such as single type of tourism experience, similar content of tourism experience, and low participation in tourism experience have emerged. Therefore, it is necessary to carry out further empirical research on tourist experience, using empirical research methods and concepts, to explore the problems existing in the intangible cultural heritage tourism experience.

As an intangible spiritual and cultural resource, intangible cultural heritage is the root that nourishes the soul of the Chinese nation. At present, intangible cultural heritage tourism is still at the stage of knowledge reserve. The maturity of theoretical research can provide guidelines for the future development of intangible cultural heritage tourism.

According to the digital protection requirements of modern cultural heritage protection, this paper studies the geographic information technology algorithm of ArcGIS, and improves the algorithm with the support of digital technology to provide technical support for the digital protection of cultural heritage.

The organizational structure of this paper is as follows: the introduction of the first part mainly describes the necessity and status quo of the digital protection of cultural heritage; the second part summarizes and analyzes the academic research status of the digital protection of cultural heritage through literature review; the third part is about the cultural heritage. The research on the algorithm of the key technology of digital protection provides the algorithm basis for the construction of the subsequent intelligent model. The fourth part builds the digital protection model of cultural heritage, and verifies the effect of the model proposed in this paper. The effective results are summarized.

2. Related Work

Regarding the research on the concept of intangible heritage, foreign scholars have experienced the process from protecting cultural property to attaching importance to the common heritage of mankind, from maintaining material cultural heritage to understanding the importance of intangible cultural heritage as the heritage of human civilization, and their research results are rich [1]. Literature [2] comprehensively defines the theoretical conceptual system of cultural heritage by comparing and analyzing the conceptual connotation of cultural heritage and cultural property, exploring the content of cultural awareness and cultural rights, etc.; Andrioti et al. [3] clarify that intangible cultural heritage is different from the key characteristics of tangible cultural heritage and the internal connection between the two also point out the problems and countermeasures in the protection of intangible cultural heritage. Lin [4] recounted the evolution of the concept of intangible heritage, and studied the standards of intangible heritage protection and related factors.

Intangible cultural heritage is a unique achievement of human civilization with multiple values. Current academic research on the evaluation of intangible cultural heritage has paid more attention to its social and economic aspects. Runhao [5] uses the contingent valuation method and the cost-benefit method to propose measures for the revival of cultural heritage. Yakar and Doğan [6] proposed that by displaying the value of intangible cultural heritage, it played a role in coordinating the conflict between North Korea and South Korea. Aparac-Jelušić [7] proposes the mutual relationship between intangible heritage values, which promotes urban development and the survival of cultural resources by expanding the tourism value of heritage, and enhances its social value. Khan et al. [8] proposed a cultural heritage protection model based on heritage values.

Research on the establishment of a policy system for protection management. Rahaman and Kiang [9] clarify the importance and urgency of intangible heritage protection, and propose that intangible heritage protection management should formulate detailed protection planning schemes, formulate and implement protection and development rules and regulations, and emphasize the scientific and orderly protection of intangible heritage. Mohammed Mahmoud Mohammed Ahmed [10] puts forward a series of protection measures based on the analysis of the status quo of intangible heritage, the exploration of the problems and causes, and realizes the sustainable development of the inheritance of intangible heritage protection. Regarding the development and utilization of intangible cultural heritage, the academic circles mainly focus on the model, development benefits, and intangible cultural heritage protection and utilization plans for individual cases. Kelly [11] pointed out that intangible cultural heritage is an important resource that stimulates social and cultural innovation and should be used to give full play to its value. Ulvi [12] believes that due to the complex social environment and the disappearance of traditional boundaries, the preservation and tourism status of intangible cultural heritage is inseparable from the local environmental factors, and the protective development of intangible cultural heritage should be based on intangible cultural heritage tourism in the local environment. Features are recognized. Rahaman [13] takes literary tourism cultural heritage as the research direction and analyzes that most of the literary tourism cultural heritage originates from the people's loyalty to literary sacred sites. Both sense of sight. Sciacchitano [14] believes that an attractive and market-compliant development model should be established to promote the planning of cultural heritage tourism.

Tang et al. [15] expounds the origin of the concept of intangible heritage, the understanding of the definition and category of intangible heritage, and puts forward its own views on the concept of intangible cultural heritage field, the key protection objects of intangible cultural heritage, and the issue of "cultural rights." Vučković et al. [16] analyze the two major types of intangible cultural heritage, namely, morphological culture and behavioral culture, of which morphological culture is the core part of intangible cultural heritage. Bec et al. [17] interpret and reconstruct the concept of intangible cultural heritage, expounds the connotation and value of the concept, and emphasizes the strengthening of research on living literary heritage. Deniz et al. [18] pointed out that the characteristics of intangible cultural heritage, such as the personality, cultural heritage, and nationality, mean its unique value. Champion and Rahaman [19] analyze the characteristics of the economic value of intangible cultural heritage and believes that attaching importance to the economic value of intangible cultural heritage is of great significance to the realization of national characteristics and the creation of new economic growth points.

3. Key Technologies for Digital Protection of Cultural Heritage

In this paper, the digital watermarking algorithm is used in the digital protection of cultural heritage, and the research on the digital watermarking algorithm is carried out first.

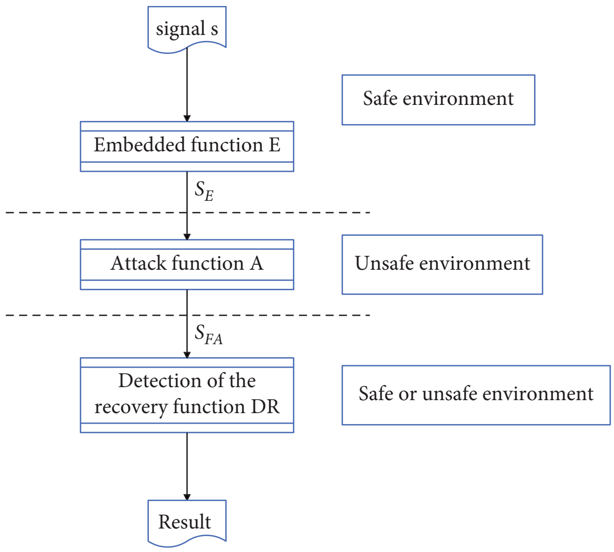

Figure 1: The life cycle of a digital watermark.

Digital watermarking has been an important research direction of information hiding technology, and it is an effective way to realize source identification, identity verification, and copyright protection. Digital watermarking technology refers to embedding secret watermarking information in digitized data content. This technology closely combines the watermark with the source data and hides it to make it an inseparable part of the source data. From this, it determines the copyright owner, verifies the ownership, tracks infringements, verifies the authenticity of the source of the digital content, identifies the purchaser, provides other additional information about the digital content, and so on.

Digital watermarking technology is a cutting-edge technology developed in the field of information security. Its characteristic is that it does not affect the use value of the original carrier, nor is it easy to be detected and modified again, but it can be identified and identified by the manufacturer.

Generally, the life cycle of a digital watermark consists of three parts: the watermark embedding phase, the data attack phase, and the watermark detection and recovery phase. Figure 1 shows the life cycle of digital watermarking. The information embedded in a signal is called a digital watermark, and the signal embedded in a watermark is called the host signal. A watermarking system is usually divided into 3 independent steps: embedding, attacking, and detecting. In the embedding process, an algorithm is needed that can process the carrier signal and watermark information at the same time and can generate a watermarked signal. Then, the algorithm can propagate or store the watermarked digital signal. If the data are modified during the propagation process, it is called an attack. However, the modification may not be malicious. The term "attack" is derived from copyright protection applications, because a third party may modify the digital watermark to remove it. Moreover, there are many ways to modify, such as data compression, image or audio cropping, or random increase

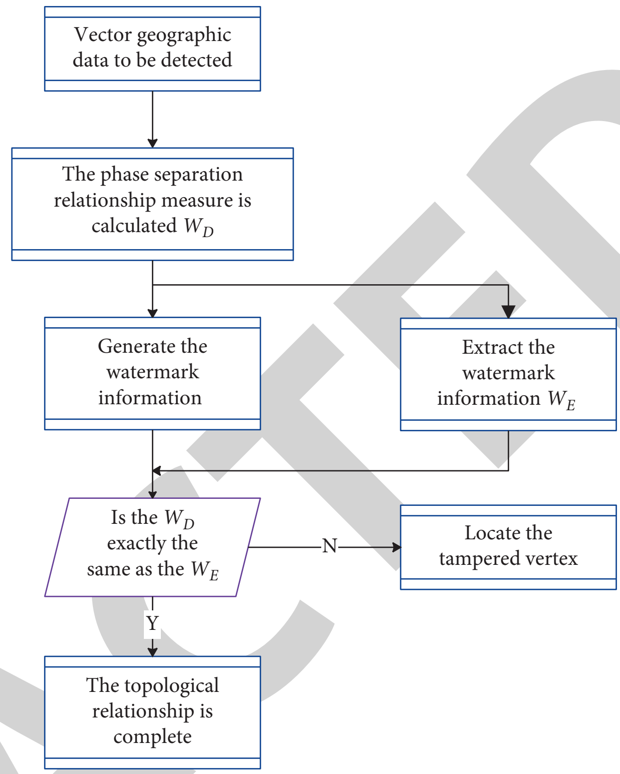

Figure 2: Checking process of topology integrity.

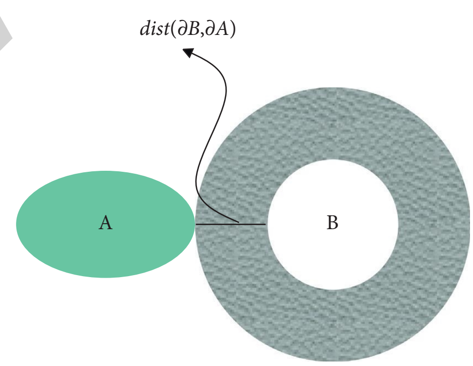

Figure 3: Schematic diagram of the calculation of the detachment relationship measurement value.

of noise. The detection (or extraction) algorithm attempts to extract the watermark from the attacked signal. If the signal is not modified during the propagation, the watermark still exists and can be extracted. In robust watermarking, even if the modification range is large, the watermark information should still be accurately extracted. In fragile watermarking, if the signal is modified in any way, the watermark information cannot be extracted.

Digital watermarking has different classification methods according to its different application purposes. According to the antiattack of digital watermarking, it can be divided into robust watermarking and fragile watermarking. Robust watermarking refers to the ability to withstand a large number of different physical and geometric distortions, including intentional and unintentional. If an attacker tries

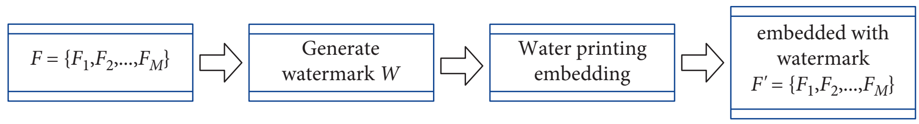

Figure 4: Flowchart of watermark embedding.

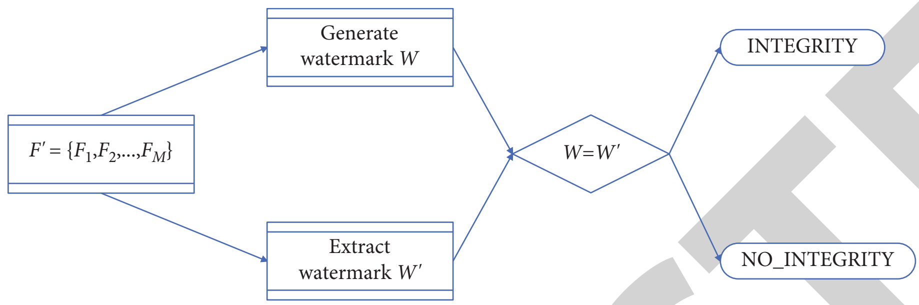

Figure 5: Flowchart of watermark detection.

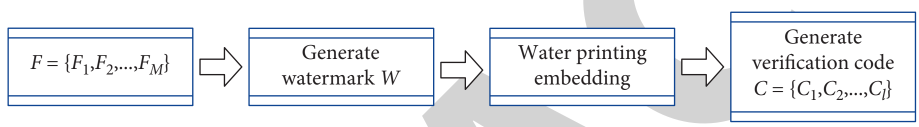

Figure 6: Flowchart of watermark embedding.

to delete the watermark, it will cause the complete destruction of digital products. The fragile watermark is to embed a digital watermark into the data under the premise of ensuring certain data quality. When the data content changes or is suspected, the watermark is extracted to identify the authenticity of the data content and point out the location of the tampering and changes, even tampering with the type, etc., so as to achieve accurate authentication of the integrity and authenticity of the data content. According to whether digital watermarks can be perceived, that is, whether they can be perceived by human vision, digital watermarks can be divided into perceptible watermarks and nonperceptible watermarks. Perceivable watermark means that the existence of a watermark can be observed, such as a logo in an image or video. The imperceptible watermark refers to the unwatermarked carrier data and the watermarked carrier data, which cannot be distinguished by human visual observation. According to whether there are private secret parameters when the watermark is embedded, digital watermarks can be divided into private watermarks and public watermarks. Private watermark means that the watermark is based on some private parameters (such as the key) during the embedding process, and only those with permission can verify the watermark information and prove the ownership of the data. However, in a private watermark, if the private parameters are leaked, the attacker can easily remove the watermark or add fake watermark information to the data through the private parameters. Public watermark means that any user can verify the watermark information multiple times to detect whether the data content has been tampered with, and this process does not require any information about private parameters.

Next, combined with the actual needs of digital protection of cultural heritage, this paper uses the vector data algorithm of GIS in the model construction.

Whether to generate watermark information, compare the generated watermark information with the extracted watermark information (or a public verification code). Then, to generate watermark information, compare the generated watermark information with the extracted watermark information (or a public verification code). If the two are the same, it is determined that the vector geographic data have not been tampered with. If the two are different, the tampered vertex position can be located according to the mismatched watermark. The specific process is shown in Figure 2.

In the vector data model of GIS, spatial entities are represented in the form of points, lines, and areas. The spatial relationship between these entities includes topological relationship, direction relationship, and metric relationship. Among them, the topological relationship is the key to spatial analysis. Topological relationship is used to describe the relationship between two objects. For example, there is a polygon on the rubber surface and a point inside the polygon. No matter if the rubber is compressed or stretched, the point still exists inside the polygon, and the spatial position relationship between the point and the polygon does not change, but the area of the polygon will change. The former is a topological relationship of space, but the latter is not a topological relationship. People generally locate a spatial target not by memorizing its spatial coordinates, but by determining the spatial position relationship between a target and other more familiar targets. This relationship is often a topological relationship, such as at which intersection or street a school is located.

The dimensionally extended nine-intersection model is a spatial model composed of the interior (A°), boundary (∂A), and exterior (A^-) of surface feature A and the interior (B°), boundary (∂B), and exterior (B^-) of B.

The dimensionally extended nine-intersection model formally describes the topological relationship of discrete spatial objects, and each element in the matrix has two values of "empty" and "nonempty." It can express a total of $2^9 = 512$ possible spatial relationships, but in reality, some relationships do not exist.

The topological relationship between any two surface features in the model is geometrically invariant, that is, translation, rotation, and zoom operations will not change the topological relationship between surface features.

The watermark information is generated according to the topological relationship between the features. The proposal of the watermarking algorithm requires the use of the concept of separation relationship measurement value. In order to calculate the separation degree between any two separated features, surface feature A is used as a reference object to measure the separation between A and B. The calculation method of the degree of separation is shown in the following formula:

$$EC(B) = \frac{\text{area}(B)}{\text{area}(B \oplus \text{dist}(\partial B, \partial A))}, \quad (1)$$

$\text{dist}(\partial B, \partial A)$ represents the shortest distance between A and B, $\oplus$ is the area expansion operator, and $\text{area}(B \oplus \text{dist}(\partial B, \partial A))$ represents the area after B is expanded by $\text{dist}(\partial B, \partial A)$. The schematic diagram of the calculation of the detachment relationship measure is shown in Figure 3.

The separation relationship measurement value is calculated from the shortest distance between two separated surface features and the area of the ground objects. The specific steps are as follows:

Step 1: the algorithm calculates the shortest distance between two surface features A and B. It is assumed that surface feature B needs to be embedded with a watermark, and surface feature A is the reference surface feature of surface feature B. If the shortest distance between surface feature B and surface feature A is 0, the algorithm replaces the reference surface feature.

Step 2: the algorithm expands the surface feature B to a position exactly tangent to the surface feature A.

Step 3: the algorithm compares the area before the expansion of the surface feature B to the area after the expansion, and the result of the ratio is the measurement value of the separation relationship between the separated surface features A and B.

A method for topological integrity verification of geographic data based on weak watermarking vectors is proposed. The watermark information is generated by the spatial separation distance between the features, and the ratio of the separation distance is modified, and the features are scaled according to the ratio to achieve the purpose of embedding the watermark. The watermark detection verifies

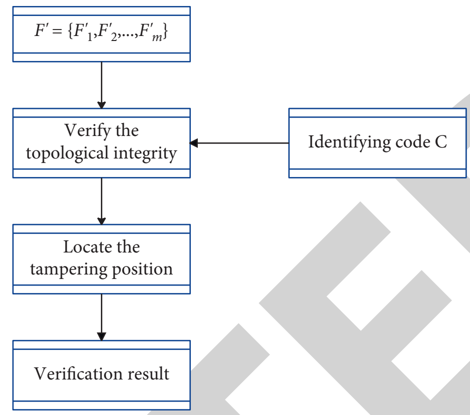

Figure 7: Flowchart of watermark detection.

the topological integrity of the vector geographic data set by judging whether the spatial topological relationship between the features has changed.

The topological integrity verification algorithm of vector geographic data is divided into two parts: watermark embedding algorithm and watermark detection algorithm. The watermark embedding algorithm first generates a watermark string according to the spatial topological relationship of the vector geographic data set, and then embeds the generated watermark string into the vector geographic data set. By slightly modifying the vector geographic data, it achieves the purpose of watermark embedding. The watermark embedding flowchart is shown in Figure 4.

The watermark detection algorithm is used to verify the topological integrity of the vector geographic data set. First, generate a watermark string from the spatial topological relationship of geographic data, and extract the original watermark string at the same time, and then compare the generated watermark string with the extracted original watermark string. If the two are the same, it indicates that the topological relationship of the vector geographic data set has not been destroyed. On the contrary, it indicates that the topological relationship of the vector geographic data set has been destroyed and its data have been tampered with. The specific watermark detection process is shown in Figure 5.

In a vector geographic data set, it usually contains many surface features, which we call features, and each feature is composed of many vertices. The set of surface features in the vector geographic data set is $F = \{F_1, F_2, \ldots, F_m\}$, and m represents the number of surface features. The set of vertices contained in each surface feature is denoted as $F_i = \{(x_1, y_1), (x_2, y_2), \ldots, (x_n, y_n)\}$, and n represents the number of vertices of the surface feature F_i.

Combined with the watermarking algorithm, the process of digital protection of cultural heritage is analyzed and identified.

Generate watermark:

(1) Calculate the shortest distance between surface features. The shortest distance between two features in the vector geographic data set is calculated. If the figure to be embedded with the watermark is B, and figure A is the reference figure of figure B, the

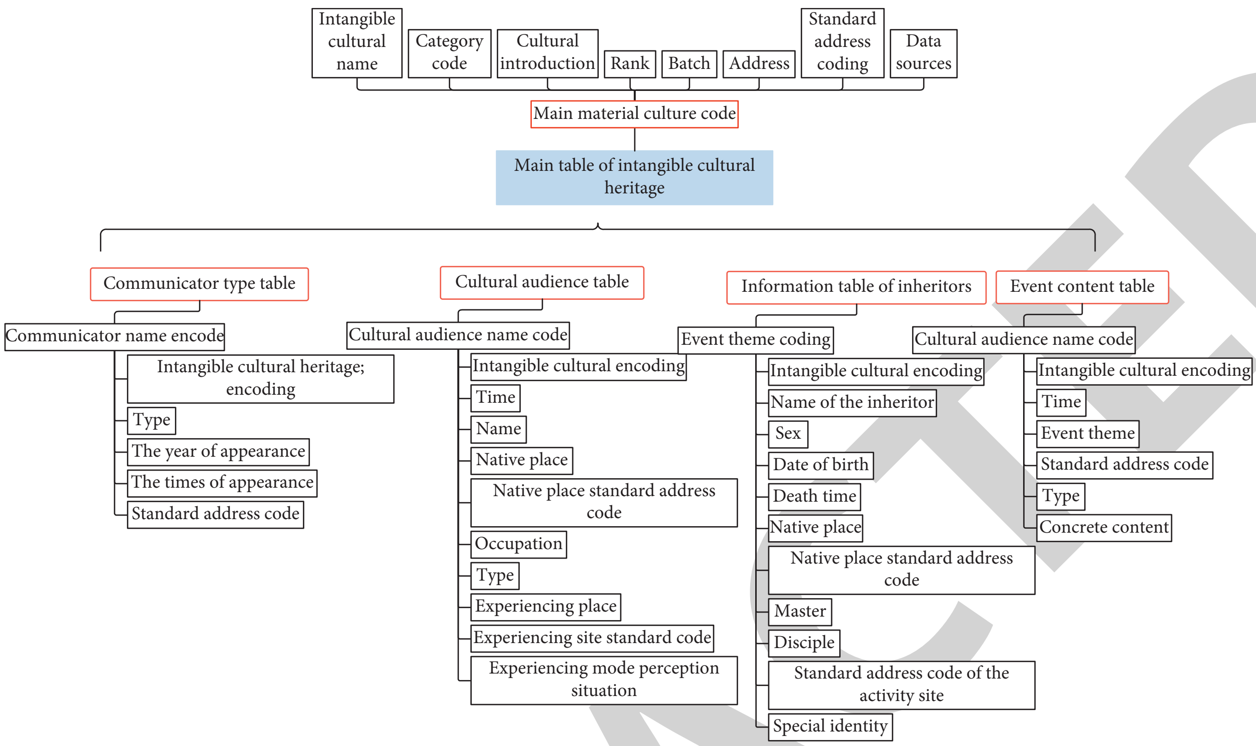

Figure 8: The structure of the attribute table centered on intangible culture.

distance between the two figures from the closest point is the shortest distance between figure A and figure B. The calculation method is as follows:

$$\text{dist}(\partial B, \partial A) = \sqrt{(x_B - x_A)^2 + (y_B - y_A)^2}. \quad (2)$$

Among them, point (x_A, y_A) and point (x_B, y_B), respectively, represent the nearest vertex coordinates between surface feature A and surface feature B.

(2) Calculate the distance value of the spatial topological relationship. The algorithm calculates the spatial distance value between the surface feature B to be embedded in the watermark and the reference surface feature A, and the result is denoted by D. The calculation method is as follows:

$$D = \frac{\text{area}(B)}{\text{area}(B \oplus \text{dist}(\partial B, \partial A))}. \quad (3)$$

Among them, area(B) is the area of surface feature B, area$(B \oplus \text{dist}(\partial B, \partial A))$ represents the area of surface feature B after expansion dist$(\partial B, \partial A)$, and the set $D = \{D_1, D_2, \ldots, D_k\}$ is obtained, and k is the length of the watermark string.

(3) Generate watermark bits. The generation of each watermark bit is calculated by the distance D_i of the spatial topological relationship. According to the obtained result, the watermark bit w_i is generated, then the watermark set is $W = \{w_1, w_2, \ldots, w_k\}$.

$$w_i = \text{Integer}(D_i) \bmod 2. \quad (4)$$

The algorithm modifies the least significant bit of the distance D_i according to the watermark bit w_i. When the watermark bit is 1, the algorithm modifies the value LSB(D_i) of the least significant bit of D_i to the range of 5–9. When the watermark bit is 0, the value f of the lowest bit of D_i is modified to the range of 0–4, as shown in formula (5). The surface feature B will be scaled according to the ratio s of the adjusted separation distance D_i' to D_i, so as to realize the embedding of the watermark.

$$\text{LSB}(D_i) = \begin{cases} 5 \sim 9, & w_i = 1, \\ 0 \sim 4, & w_i = 0. \end{cases} \quad (5)$$

The fragile watermark method can simply and effectively detect the topological integrity of vector geographic data, but the only disadvantage is that the original data value needs to be modified during the watermark embedding process. When the data accuracy is very high, and the data user does not want to modify any original data value, the fragile watermark method cannot meet this demand. Therefore, in order to solve the above problems and to verify the integrity of the topological relationship of vector geographic data for many times, a vector geographic data topological integrity verification algorithm based on public watermark is proposed. The data user can verify the topological integrity of the vector geographic data through the obtained public verification code on the public platform.

The watermark embedding process is mainly divided into three steps: watermark generation, watermark embedding, and verification code generation. The watermark embedding process does not modify the original data value, and the watermark embedding flowchart is shown in Figure 6.

(1) Calculate the shortest distance between surface features. The algorithm assumes that the surface feature to be embedded in the watermark is B, and surface feature A is the reference surface feature of surface feature B. Then, the distance between the two surface features from the closest point is the shortest distance between surface feature A and surface feature B, and the calculation method is as follows:

$$\mathrm{dist}(\partial B, \partial A) = \sqrt{(x_B - x_A)^2 + (y_B - y_A)^2}. \tag{6}$$

Among them, (x_B, y_B) and (x_A, y_A) represent the nearest vertex coordinates on surface feature B and surface feature A, respectively. If the value of $\mathrm{dist}(\partial B, \partial A)$ is 0, then the surface feature B is matched with another surface feature. When the shortest distance between the two surface features is not 0, the matching is successful. The reference surface feature of surface feature B is no longer used as the reference surface feature of other surface features that need to be embedded with watermark, and will not be embedded with watermark information.

(2) Calculate the distance measurement value of spatial topological relationship. The algorithm calculates the spatial separation metric value between the surface feature B to be embedded in the watermark and the reference surface feature A, and it is denoted by D. The calculation method is as follows:

$$D = \frac{\mathrm{area}(B)}{\mathrm{area}(B \oplus \mathrm{dist}(\partial B, \partial A))}. \tag{7}$$

Among them, $\mathrm{area}(B)$ is the original area of surface feature B, and $\mathrm{area}(B \oplus \mathrm{dist}(\partial B, \partial A))$ is the area after B is expanded by $\mathrm{dist}(\partial B, \partial A)$. After calculating the distance measurement values of all surface features in the geographic data set, a set of distance measurement values $D = \{D_1, D_2, \ldots, D_l\}$ is obtained, where l is 1/2 of the total number of surface features in the geographic data set.

(3) Generate watermark. The generation of the watermark is calculated by the distance D_i of the spatial topological relationship. The algorithm hashes D_i into a value W_i of length n, $W_i = \{w_1, w_2, \ldots, w_n\}$ is the watermark information of the current surface feature, and n is the total number of vertices contained in the embedded watermark surface feature.

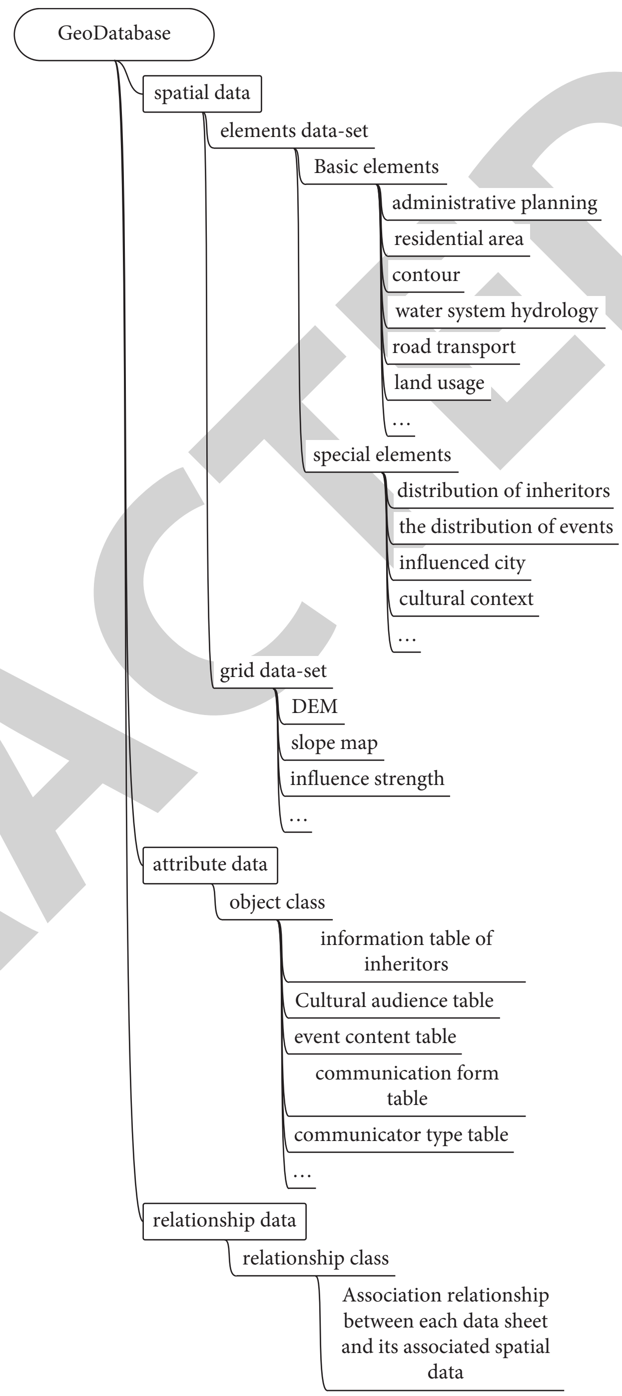

Figure 9: Database model.

$$W_i = \mathrm{Hash}(D_i, n). \tag{8}$$

First, the algorithm modulates the coordinate value of each vertex of the embedded watermark surface feature to 2 to obtain the bit position $V_i = \{v_1, v_2, \ldots, v_n\}$ of each vertex of the surface feature. Then, the algorithm performs an XOR operation on each bit of the watermark bit W_i and each bit of V_i to obtain the surface feature verification code c_i. The calculation method is as follows:

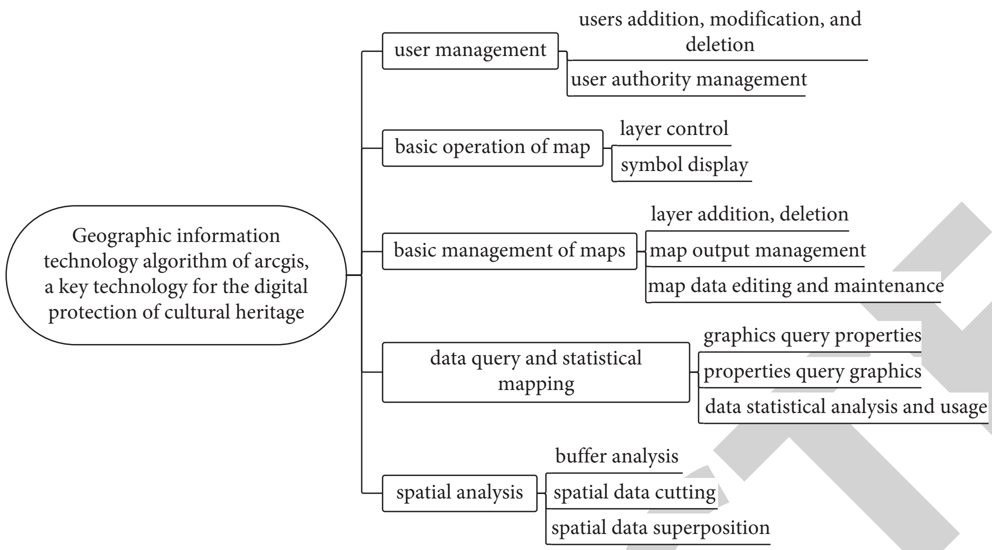

Figure 10: The overall function module of the system.

$$W_i \otimes V_i = c_i. \tag{9}$$

In the watermark detection, the calculated spatial separation relationship distance value is first compared with the public verification code, and the topological integrity of the vector geographic data set F'' is determined according to the comparison result. If the spatial topological relationship of the features is destroyed, the unmatched verification code can be used to locate the tampered location. The watermark detection flowchart is shown in Figure 7.

The algorithm verifies the topological integrity.

(1) Calculate the shortest distance between surface features. The shortest distance between the two surface features in the vector geographic data set is calculated. The calculation method is the same as formula (6) in the watermark embedding.

(2) Calculate the distance measurement value of spatial topological relationship. The algorithm calculates the spatial distance between the surface feature B and the reference surface feature A to be watermarked, denoted by D', and the calculation method is as follows:

$$D' = \frac{\text{area}(B)}{\text{area}(B \oplus \text{dist}(\partial B, \partial A))}. \tag{10}$$

The algorithm obtains the set $D' = \{D'_1, D'_2, \ldots, D'_l\}$ of distance values of the vector geographic data set.

(3) Verify topology integrity. The algorithm extracts the D_i in the verification code C_i, and compares the extracted D_i with the generated D_i. If D_i and C_i are the same, it means that the surface feature has not been tampered with. If they are different, it means that the surface feature has been tampered with, and then the position of the tampered vertex needs to be further found.

Determine the location of tampering:

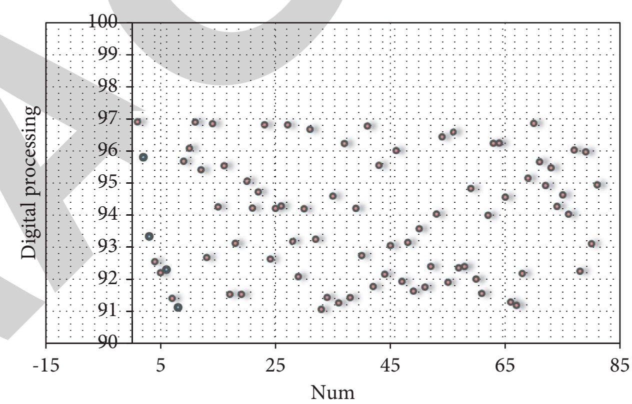

Figure 11: Statistical diagram of the effects of key technologies in the digital protection of cultural heritage.

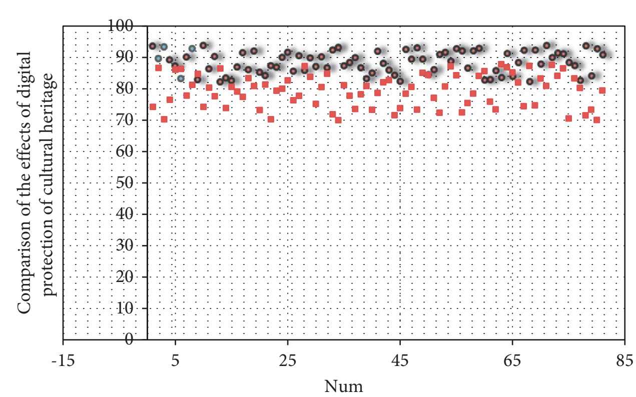

Figure 12: Comparison of algorithm effects.

(1) Restore watermark information. The algorithm extracts c_i in the verification code C_i, and hashes D_i according to the length n of c_i to obtain the original watermark information $W_i = \{w_1, w_2, \ldots, w_n\}$.

$$W_i = \text{Hash}(D_i, n). \tag{11}$$

Table 1: Method comparison results.

Number	The method of this paper	The method of Yakar and Doğan [6]	Number	The method of this paper	The method of Yakar and Doğan [6]
1	86.41	64.19	25	76.98	69.45
2	70.72	68.33	26	75.01	58.38
3	78.55	59.61	27	79.64	70.18
4	82.44	58.21	28	86.96	70.79
5	76.81	62.18	29	85.76	69.49
6	76.32	58.85	30	78.93	68.65
7	85.81	69.16	31	84.14	63.17
8	79.78	60.04	32	73.37	64.17
9	79.93	70.82	33	74.93	59.65
10	86.01	63.41	34	83.44	69.73
11	72.46	58.53	35	72.52	63.27
12	77.06	59.44	36	77.51	64.60
13	79.97	67.34	37	86.80	68.13
14	70.20	63.01	38	83.73	64.46
15	80.11	69.32	39	72.03	63.89
16	84.13	58.43	40	73.35	65.61
17	77.99	59.87	41	79.97	60.16
18	83.88	61.04	42	75.82	68.20
19	79.19	66.68	43	81.47	64.96
20	78.68	63.98	44	76.39	64.98
21	80.06	61.24	45	85.25	63.83
22	79.66	63.49	46	79.81	70.32
23	86.74	58.38	47	86.15	59.76
24	72.38	59.88	48	84.09	62.23

(2) Determine the location of tampering. The algorithm performs XOR on the extracted original watermark information W_i and c_i to obtain all the original vertex values V_i of the surface feature. At the same time, the algorithm modulates all vertex coordinates of the current surface feature with 2 to generate $V'_i = \{v'_i, c'_2, \ldots, v'_n\}$. Then, the algorithm compares V_i and V'_i. If V_i and V'_i are completely equal, the current surface feature has not been tampered with; otherwise, the tampered vertices can be found by filtering the vectors where V_i and V'_i are not equal.

4. Digital Protection Technology of Cultural Heritage Based on ArcGIS Geographic Information Technology Algorithm Model

When conducting a special research on a certain intangible culture, we first search for a certain cultural name according to the intangible cultural code, and match the corresponding spatial location data and event content according to the standard address code and cultural introduction in the search results. Moreover, we query the detailed content of the event according to the event subject code in the event content table, and learn the basic information of the inheritor and the scope of space activities by querying the inheritor code. In addition, we use the communicator type code to connect the inheritor information table and the event content table, etc., as shown in Figure 8.

This article uses ArcGIS' geographic information technology algorithm and Geo Database to construct a spatiotemporal database. The database includes three parts, namely, spatial data, attribute data, and relational data. The basic structure of the spatiotemporal database is shown in Figure 9. Among them, the attribute data include the inheritor information table, cultural audience table, event content table, dissemination form table, and communicator-type table integrated above. The relationship data defines the connection fields and association relationships between the tables, and is associated with a unique identification code.

The overall function module diagram of the system is shown in Figure 10.

After constructing the above model, the effect of the system model constructed in this paper is verified, the digital processing of cultural heritage is verified, and the digital verification results are counted, and the results shown in Figure 11 are obtained.

As can be seen from the above figure, the key technologies for the digital protection of cultural heritage proposed in this paper have good effects in the digital processing of cultural heritage. After that, the performance of the algorithm proposed in this paper is verified, and the method proposed in this paper is compared with the traditional method, and the result shown in Figure 12 is obtained.

The research content of this paper is compared with the method proposed in the literature [6], and the results are shown in Table 1.

From the above research, we can see that the digital protection technology of cultural heritage based on ArcGIS geographic information technology algorithm in this paper can play an important role in the digital protection of cultural heritage.

5. Conclusion

Cultural heritage is very important for local and national cultural construction. The existence of intangible heritage has become an important content that needs to be protected in the process of human civilization, and it is also the theme of cultural exchanges between social groups and countries. These cultural heritages have become the key to enhancing the cohesion of the nation and the soft power of regional culture. However, due to the continuous development of economic globalization, the cultural tourism market has gradually risen, and the eager pursuit of economic benefits has caused the excessive development of the local traditional cultural space. The intangible cultural heritage attached to it has also been eroded by modern civilization and is precarious or even disappeared. According to the digital protection requirements of modern cultural heritage protection, this paper studies the geographic information technology algorithm of ArcGIS, and improves the algorithm with the support of digital technology. The research shows that the digital protection technology of cultural heritage based on ArcGIS geographic information technology algorithm in this paper can play an important role in the digital protection of cultural heritage.

Data Availability

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

Conflicts of Interest

The authors declare no conflicts of interest.

Acknowledgments

This study was sponsored by 2021 Henan Provincial Federation of Social Sciences Research Project (SKL20212273), "Application Design and Innovative Communication Research on the Protection of the Yellow River Cultural Heritage from the Perspective of Digital Intelligence" Phased Research Results.

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