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Digital Modeling of Intangible Cultural Heritage Visualization Based on Convolutional Neural Networks

Lanlan Zhang

School of Design and Product, Jilin Animation Institute, Changchun, Jinlin 130000, China, zhanglanlan4172@126.com

Corresponding author: Lanlan Zhang, zhanglanlan4172@126.com

Abstract. This article introduces an innovative digital modelling method tailored for ICH using the functionality of Convolutional Neural Networks (CNN). In order to further improve the performance of CNN, we seamlessly integrated a genetic algorithm (GA) into the system, thus establishing an immersive interactive visual learning environment. This integration utilizes GA's proficiency in conducting comprehensive global searches and its ability to optimize through genetic operations such as crossover and mutation iteratively. The parameters of CNN are fine-tuned based on the fitness value, which represents the most accurate solution with the smallest deviation. This study has achieved remarkable results. Compared with traditional modelling techniques, CAD technology has shown significant advantages in modelling accuracy. In terms of visual teaching, CAD technology enables students to intuitively understand the structure and characteristics of intangible cultural heritage by creating realistic 3D models. This intuitive teaching method not only stimulates students' interest in learning but also helps them gain higher cultural and material value. This method helps to promote a deeper appreciation and understanding of our rich cultural heritage among the younger generation.

Keywords: Intangible Cultural Inheritance; Convolutional Neural Networks; Digital Modeling; Visual Teaching
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1 INTRODUCTION

The rich heritage has profound historical and cultural significance, forming the pillar of our different cultural characteristics. However, in the ruthless process of modernization, a considerable number of ICHs are quietly disappearing and facing the threat of extinction. The urgent need for effective dissemination and careful protection of this priceless cultural heritage has never been so obvious. Banfi [1] aims to promote culture by combining visual expression techniques with the regional and unique characteristics of culture in its design. It is intended to design works with local characteristics and avoid uniform design patterns. Visual information should not only be used to convey the final style of culture but also to transform the details of its production materials, tools, processes, etc., using design techniques. This strengthens the viewer's understanding of culture and their in-depth understanding of its cultural connotations. Visual construction is an indispensable part of documentaries and unique and reasonable visual construction. Therefore, Butnariu [2] applies visual construction theory to analyze artistic techniques in documentary films and the artistic effects they express. The paper first elaborates on the value, connotation, and definition of visual construction documentaries. Then, the visual construction art of intangible cultural heritage documentary films was analyzed from three aspects: visual element characteristics, lens and image representation, and overall visual construction style. For the research on the visual construction of intangible cultural heritage documentaries, Comes et al. [3] searched for "Visual Construction of Intangible Cultural Heritage Documentaries" under the theme of "Visual Construction". After reading relevant literature, the author has gained a general understanding of the visual construction theory research on documentaries. Most literature papers that study documentaries on intangible cultural heritage comprehensively explain various aspects. However, in terms of the preservation of material culture, it is still necessary to conduct frame-by-frame detailed research, construction and analysis. Through innovative contributions to visual construction, it analyzed scarce information points.

Demenchuk et al. [4] explored the visual image composition and design of some excellent expos. And analyze the current situation of its visual image. Secondly, we will conduct research on the visual image design system of previous expos to identify areas for improvement and enhancement. Once again, the significance and value of regional characteristic culture in the visual image of the Intangible Cultural Heritage Expo were analyzed, as well as the role of the exhibition's visual image in the dissemination of regional culture. Furthermore, we will fully collect local characteristic cultures and representative intangible cultural heritage products, laying the foundation for future design practices. Finally, based on this, the visual image design of the Expo is completed by selecting regional culture and intangible cultural heritage as design elements. Although some scholars have conducted extensive. But no one has yet proposed the concept of visual image design for the Intangible Cultural Heritage Expo from a holistic, systematic, and comprehensive perspective, and conducted more in-depth theoretical exploration and research on this topic. Ding et al. [5] believe that the visual image design of the Rizhao Heritage Expo is an example of research. Computer-aided design (CAD) technology is renowned for its precise modelling, design accuracy, and eye-catching visual representation, making indelible contributions to multiple engineering disciplines such as architecture, machinery, and electronics. This outstanding technology injects vitality into typically complex design processes, transforming abstract concepts into tangible reality. By utilizing the power of digital modelling, CAD not only accurately replicates the complex forms, vibrant colours, and complex structures of ICH, but also preserves its authenticity, thereby supporting education, research, and cultural exchange work.

The connection between regional intangible cultural heritage exhibitions and local culture is inseparable, and there must be a concentrated reflection of regional cultural characteristics. The two complement and promote each other. Culture has always been the core driving force for expos that lack local cultural characteristics is a soulless product, and regional cultural characteristics also need to be presented through the visual image of expos. The aesthetic and artistic value endows the Intangible Cultural Heritage Expo with recognizability and aesthetics. Commercial value is the solid foundation Expo, and cultural value is the core and soul of the Expo. So in visual image design, it is necessary to consciously coordinate three factors, and pay attention to their relationships and differences [6]. As the core element in visual image design, logos are the most commonly used, frequently used, and have the most profound impact. It mainly constructs a display space through a combination of elements such as text, symbols, and shapes. In this space, it is required to include both the main information of the exhibition and provide the audience with a certain imagination space. The most important thing is to leave a profound visual impression in the audience's mind. By using visual language to communicate with the audience, we can attract them to the fullest extent and form long-lasting memories. The visual image design of the Expo needs to be considered from a holistic perspective in order to connect elements scattered in various corners. There is a lot of visual information that needs to be presented in exhibitions, which requires designers to establish a clear thinking structure, extract information according to actual needs, and integrate content. Ham et al.

[7] considered the overall relationship between logos, standard colours, mascots, posters, and derivatives. Construct harmonious visual symbols and integrate them with cultural concepts to form a relatively complete visual image system.

However, the dissemination of ICH faces many obstacles, especially when it comes to the subtle and unstable nature of handicrafts and verbal communication in today's society. With the retirement of skilled craftsmen, their valuable knowledge and practice may disappear forever. In addition, the ruthless pace of modernization poses a significant threat to the dissemination and continuation of ICH. Therefore, there is an urgent need to adopt modern technologies, including computer-aided design, to protect and promote this rich heritage. Due to the diversity and uniqueness of ICH, digitization is a daunting task that brings enormous technological challenges. However, deep learning, especially CNN, provides a novel solution. CNN excels in image processing and recognition, and through rigorous training, delves into the core features of images to achieve precise recognition. When used in conjunction with CAD, CNN skillfully extracts key ICH elements, achieving an exceptionally accurate digital representation of ICH culture, and capturing its essence and beauty.

In order to restore people's interest in ICH and ambassadors, it is imperative to seamlessly integrate ICH into educational curricula. By utilizing CAD technology to create an immersive interactive visual teaching environment, we can showcase all the highlights of ICH culture in digital form. This innovative method can intuitively understand the profound essence of ICH, arouse students' curiosity, and lay a solid foundation for its continuation and enrichment.

In this article, we delve into groundbreaking teaching methods that utilize the power of CAD technology to model and visualize ICH work. By combining CNN with other advanced algorithms, we have introduced a revolutionary ICH digital modelling method that seamlessly integrates into a captivating interactive teaching platform.

In today's constantly evolving digital age, it is crucial to use advanced tools to protect and sustain ICH. CAD brings new perspectives and innovative methods to education. By utilizing cutting-edge tools such as CAD and deep learning, we can effectively document, showcase, and disseminate the unique charm and rich heritage of intangible cultural heritage to future generations.

The contributions of this paper can be summarized as follows::

(1) This article proposes a new method for preserving ICH, combining CAD technology with advanced digital tools.

(2) We use CNN for the digital representation of ICH and utilize deep learning to accurately identify the features of ICH, improving the accuracy of digital replication.

(3) In order to further improve modelling accuracy, we use a genetic algorithm (GA) to optimize CNN parameters, thereby improving the overall performance of the model.

(4) In addition to digital protection, this article also explores the educational purposes of modelling intangible cultural heritage. By establishing an interactive platform, we make ICH research more attractive and accessible.

Outline of the article: Firstly, the introduction delves into the significance and challenges of ICH, emphasizing education. Next, the literature review provides an overview of the progress of CAD and existing research on ICH digitization. Then the main section provides a detailed introduction to the CNN-based ICH digital modeling method, explaining how GA enhances model parameters. Finally, the research method was experimentally validated and a conclusion was drawn, emphasizing the role of digital technology in protecting ICH and outlining future exploration approaches.

2 LITERATURE REVIEW

Still represents the profound cultural heritage of humanity. As an intangible cultural heritage, embroidery only has symbols and lacks a complete brand visual recognition system. Not conducive to the promotion of embroidery brands, and even less conducive. Han et al. [8] learned 3D global features by focusing attention on aggregating sequence views. In terms of the visual recognition system of embroidery brands, in accordance with the requirements of modern design, we will improve the basic design and application design of the embroidery brand's visual system from the perspective of brand design elements and principles. In this process, applying the brand image to the dissemination of new technology can attract more attention from young consumer groups. This has assisted in the dissemination and promotion of the embroidery brand of Daye Embroidery, an intangible cultural heritage. Brand image visual design can accurately convey information and use sophisticated symbols to help the audience store brand memories. Text, graphics, and colours are equivalent elements of visual design, whether it is the design and arrangement of text or the combination and application of graphics. The use of colour plays a crucial role in visual design. These independent elements are recombined and integrated to form a complete brand visual image with cultural value, bringing new vitality and competitiveness to the enterprise brand. For the visual image design of a brand, there will be different design trends and trends in each stage and period. Hou and Zhang [9] analyzed the visual image design of cultural heritage brands should grasp the theme of modern aesthetic concepts, from complexity to simplicity, and from complexity to singularity. The flattening and other changes in information graphics reflect a trend in modern design concepts.

Previously, graphic design was static and singular, but now it has shifted towards dynamic and multimedia visual diversity and diversified development. With the integration of information technology and the maturity of digital technology, people's information transmission and interactive communication have greatly improved. Many brand promotions have taken into account the interactivity and relevance of apps. For example, Taohuawu woodcut New Year paintings have been widely disseminated in the form of Weibo, establishing their external image and awareness. Therefore, in cultural heritage, the application part of a visual image recognition system can be developed for mobile apps, allowing consumers to feel the artistic appeal of embroidery on the terminal. Luther et al. [10] presented a visual image that no longer presents monotonous and fixed graphics but rather features multi-sensory interaction, dynamic expression, and interactive communication. The visual image design of intangible cultural heritage exhibitions is different from ordinary paintings or other artworks and often includes a certain degree of functionality and practicality. The visual image of the Intangible Cultural Heritage Expo must be combined with the theme and characteristics of the exhibition, using various communication methods to adapt to the requirements of diversified promotion. In addition, from a humanistic perspective, the psychological and physiological needs of the audience should be the focus of detail design, with special attention paid to meeting the needs of special groups. By studying and organizing the visual image design of relevant exhibitions, we have better drawn on past experience and provided design ideas for the visual image exhibitions. Mendoza et al. [11] analyzed the sustainability of cultural heritage protection technologies. In the following design practice, we will leverage our strengths, make up for our shortcomings, and continuously summarize and create works that align with the exhibition theme and characteristics.

The extensibility of visual elements mainly refers to lens and image elements that do not have subjective emotions or emotions. Under the clever arrangement of the creators, symbolically representing a strong emotion or emotion is an important aspect of documentary visual construction. In intangible cultural heritage documentaries, there are many objects with distinct styles that do not possess subjective emotions, but their strong and unique distinctive style makes them expendable. This characteristic is one that creators can utilize when constructing the visual structure of documentaries. Nowadays, many excellent documentaries are utilizing the extensibility of visual elements to construct visual images of characteristic objects in intangible cultural heritage, enabling them to obtain corresponding artistic images. Moreover, by utilizing the extensibility of visual elements, it is possible to guide the audience's imagination and association and construct an artistic image full of memories and emotional sustenance in the audience's mind [12]. It juxtaposes contrasting visual elements in visual construction. In visual construction systems, there are few visual elements with absolutely opposite meanings. But visual elements with vastly different styles can to some extent replace the role of antonyms in language systems. Therefore, using props and environments with contrasting styles plays an important role in the visual construction of the documentary. In intangible cultural heritage documentaries, there are many works that are shot by craftsmen, and these handicraft works are often full of personal style characteristics or Chinese classical colours [13].

Culture and innovation have always been the core driving force behind the visual image of the Intangible Cultural Heritage Expo. Culture takes root, innovation makes it flourish. Therefore, Saleh et al. [14] integrated the visual image of the Rizhao Intangible Cultural Heritage Expo with regional representative culture. Integrate various design elements to create a unique visual image system design for the Intangible Cultural Heritage Expo. And endow the intangible cultural heritage expo with deeper cultural connotations in its visual image. It is also important to recognize that the development of ideas and visual presentation of intangible cultural heritage exhibitions should not be limited to rigid forms. Experience can be drawn from past designs, while also facing the future and the public, seeking innovative points and breakthroughs. Revitalize the visual image of the Intangible Cultural Heritage Expo. Skublewska et al. [15] attempted to use digital narrative as a unique perspective for studying. It divides narrative units from a digital perspective in terms of material and cultural aspects. Through practical analysis of typical cases, a narrative element perspective framework for digital core has been constructed. Extracted key elements such as time, space, media, and effects involved in digital narrative in intangible cultural inheritance. These elements not only reflect the important role of digital narrative in the inheritance of intangible cultural heritage but also provide an important basis for constructing effective inheritance paths. This path aims to fully utilize the advantages of digital technology and promote the inheritance and development of intangible cultural heritage through innovative narrative methods and means. Including spatiotemporal scenes, interactive media, and narrative experiences. This provides a reference for the dissemination and enhancement of public awareness and deep participation.

The research on digital narrative in China has focused on the past two years, exploring the basic forms and mechanisms of digital narrative from a media perspective. The new situation brought about by digital storytelling, and how it can be applied interdisciplinary in the inheritance of intangible cultural heritage, combined with cultural resources [16]. Research on digital narratives in foreign countries started earlier than in China, mainly focusing on how digital technology can be more effective and accurate. From the perspective of intangible cultural heritage inheritance and digital narrative methods, foreign countries have proposed the use of storytelling to disseminate intangible cultural heritage information. By using digital methods to record memories and combining virtual reality technology, visitors can achieve interactive experiences in virtual spaces with storylines, promoting the exchange [17]. Domestic scholars have proposed using digital technology to promote every stage, from protection to inheritance. It can be seen that domestic and foreign researchers have focused more on the research inheritance methods, neglecting the role of narrative in intangible cultural heritage inheritance [18]. The visual construction from a humanistic perspective presents a film style that is more approachable and in line with the actual life of the public compared to the textbook-like straightforward style. Therefore, this style has been favoured by the audience. Of course, this has to some extent resonated with the audience's feelings, and at a deeper level, the overall visual construction from a humanistic perspective has to some extent led the audience's aesthetic orientation towards documentaries in the current era [19].

3 CNN-BASED ICH DIGITAL MODELING METHOD

In the field of digital expression, this article emphasizes an innovative modelling technique that utilizes the ability of CNN (Convolutional Neural Network) to identify key attributes of visual effects of intangible cultural heritage and combines GA (Genetic Algorithm) to fine-tune CNN variables, thereby improving the accuracy and speed of modelling.

CNN is a specific type of deep learning mechanism aimed at processing image data. The task of the convolutional layer is to extract local details from the input image through the convolutional process, while the function of the aggregation layer is to compress these details, reduce the number of parameters, and retain key data. The educational system designed in this study utilizes visual aids for teaching and exhibits a significantly reduced error rate in image matching, emphasizing its excellent ability to accurately recognize and display unique features and information embedded in ICH projects. This innovative approach not only enhances the learning experience but also demonstrates the accuracy of the system in highlighting the complex details and valuable information contained in these culturally significant efforts. By utilizing visual aids, the system ensures a comprehensive understanding and appreciation of the ICH project and further protects and promotes cultural heritage through accurate presentation.

$$\begin{cases} X_{c1} = R_1 X_w + t_1 \\ X_{c2} = R_2 X_w + t_2 \end{cases} \tag{1}$$

$$X_{c1} = R_1 R_2^{-1} X_{c2} + t_1 - R_1 R_2^{-1} t_2 = R X_{c2} + t \tag{2}$$

This process requires the use of the origin of the base point (defined as (0, 0, 0) and the corresponding determination of the directions of the three main axes to serve as directional markers.

By utilizing spatial features inferred from vanishing points, it becomes feasible to adjust and fine-tune images obtained from typical digital cameras. Through this calibration, the intrinsic and extrinsic rotation parameters of the camera can be determined. Conversely, this facilitates computationally intensive tasks of obtaining a three-dimensional representation of the scene from two-dimensional photo depictions. To gain a clearer understanding of this vanishing point calibration concept, please refer to Figure 1.

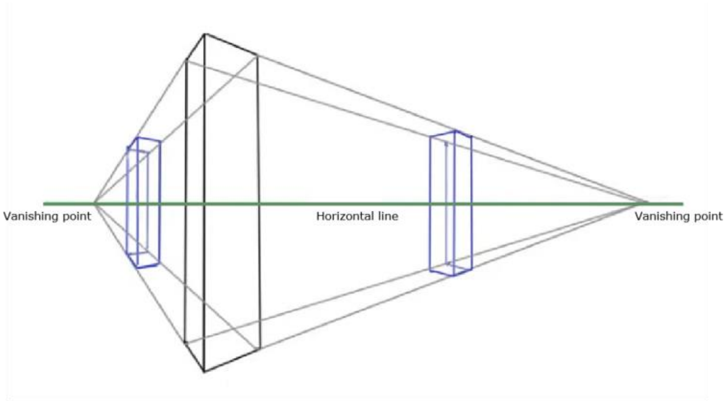

Figure 1: Illustrates the concept of vanishing point adjustment.

The translation matrix is responsible for moving the position of the image, and the 3x3 camera calibration matrix is used for calibration and precise adjustment of camera parameters. This decomposition method helps to manage the complexity of projection matrices, thereby more accurately controlling the transformation and calibration process of images.

$$P = M\left[I\middle|M^{-1}P_4\right] = KR\left[I\middle|-C\right] = K\left[R,T\right] \tag{3}$$

In the field of perspective projection, lines that extend into the real world but do not converge will still converge at the focal point on the projected image, which is called the vanishing point. Although there may be countless such points in a three-dimensional Cartesian grid, only those vanishing points aligned with the three main axes are considered important, with a total of no more than three.

As described in detail here, the method of creating a 3D open model is a two-stage operation. It starts from the fixed observer's perspective and then calculates the positions of all obstacles that hinder observation from that perspective in each imaginable direction. Then, using the evaluation criteria discussed earlier, thoroughly examine the spatial characteristics of these obstacles. For a detailed description of this process, please refer to Figure 2.

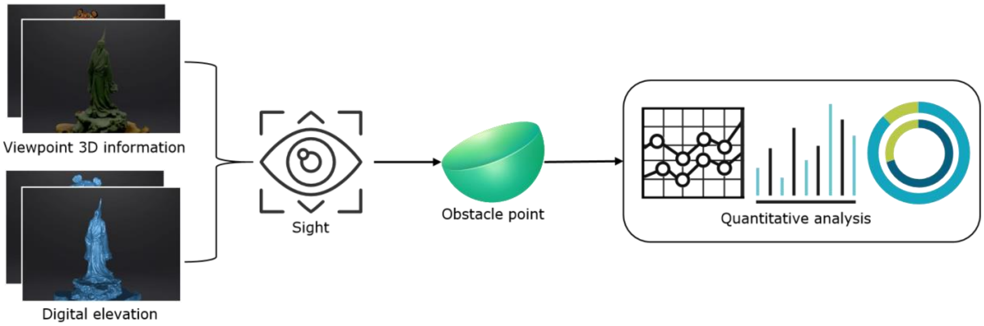

Figure 2: Explanatory guidelines for 3D open model execution.

The initial processing of ICH image data includes multiple preprocessing steps. These include adjusting image size to standard size, converting between colour spaces, and reducing noise to ensure consistency and high-quality input data. In the model creation phase, a multi-layer CNN architecture was used, integrating various convolutional layers, pooling layers, and dense layers. In order to enhance the adaptability of the model and prevent overfitting, a descent layer was added after the dense layer. Which is crucial for subsequent modelling and visual presentation.

$$A\ \ x,y,\sigma\ \ = B\ \ x,y\ \ \otimes C\ \ x,y,\sigma \tag{4}$$

Using adversarial learning to incorporate a small amount of local interference noise into the image forces the model to undergo more training to identify tampered areas. The frequency separation sensing module determines the high-frequency noise characteristics of the forged area by separating multi-scale frequency domain features and retrieves low-frequency information from the RGB domain. The model simultaneously learns edge and noise information in both spatial and frequency domains. The experimental results on five commonly used benchmark datasets show that compared to other supervised learning model structures, FP Net has strong robustness and universality. The global frequency attention module interactively learns each other's feature information to integrate spatial and frequency domain content and improve the overall perception of tampering with physical locations.

$$D\ \ x,y,\sigma\ \ =\ \ C\ \ x,y,n\sigma\ \ - C\ \ x,y,\sigma\ \ \ \otimes B\ \ x,y \tag{5}$$

Effective geometric operations or integration of contextual semantic content can be achieved by calculating the spatial information of images. The spatial attention mechanism is manifested as finding the unknown regions in the image that require the most attention. In this way, the very important information in the image can be extracted. Use optimization methods to determine the spatial position of the point X. The function accurately calculates the distance between the actual image point and the corresponding reprojection point through geometric differences. The core lies in constructing an accurate geometric error cost function. By judging the actual image points and their reprojection points between projection points, it is possible to effectively reduce the geometric differences between these points, thereby improving the accuracy and reliability of image processing.

$$C = d\left(m,\hat{m}\right)^2 + d\left(m',\hat{m}'\right)^2, \quad \hat{m}'^{T}\ \ F\hat{m} = 0 \tag{6}$$

Consider $d\ *,*$ as a measure of the Euclidean distance between points. Within this framework, $\hat{m}$ is transformed into $\hat{m},\hat{m}'$ through the projection matrix that resonates with F. In order to accurately locate the cost function, an optimization strategy was adopted. For the purpose of our research, we chose the L-M algorithm to calculate the spatial localization of points.

During the texturing process on the surface of the triangulated object, the grayscale values of pixels in the new image are fine-tuned to match the grayscale of the original image. This calibration is achieved by using standard affine projection transformation methods:

During the texture process on the surface of the triangulated object, the grayscale values of pixels in the new image are fine-tuned to match the grayscale of the original image.

$$x = Ax^{'} + t \tag{7}$$

Although CNN excels in feature extraction, the selection of its parameters has a crucial impact on the performance of the model. In order to accurately locate the optimal parameter set, we utilize the powerful capabilities of genetic algorithms for parameter adjustment.

The genetic algorithm draws inspiration from natural selection and genetic principles, simulating the processes of selection, recombination, and mutation in biological evolution to find the most suitable solution to a given problem. In the optimization process of CNN parameters, each parameter tuple is considered a unique "individual." Through the selective pressure, recombination, and random variation of genetic algorithms, we gradually refine and ultimately identify parameter tuples that maximize CNN performance.

Genetics reflects the inherent selection pressure in biological evolution. The two key operations in genetic algorithms are recombination and mutation. Recombination involves the exchange of genetic material between different individuals, similar to the process of biological reproduction, resulting in offspring inheriting the characteristics of both parents. On the contrary, mutations require random modification of specific genetic information in chromosomes with a given probability in order to produce new offspring with unique characteristics.

This innovative idea eliminates the requirement of manually adjusting parameters to maintain population diversity, ultimately reducing computational complexity. Figure 3 visually illustrates the operation process of the improved GA algorithm, demonstrating how the integration of crowding distance simplifies the performance of the algorithm and ensures a more optimized and efficient search process. By automatically managing population diversity, algorithms become more robust and adaptable, significantly improving their ability to find optimal solutions.

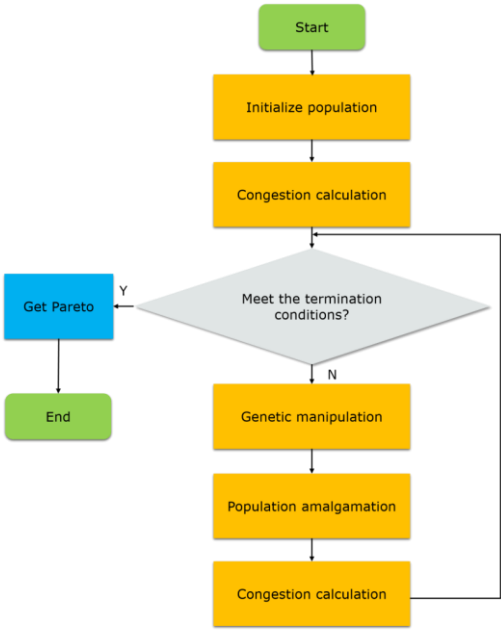

Figure 3: Algorithm process.

In the process of sorting non-advantages, only elite individuals from the highest advantage level are selected to spread the gene pool for the upcoming generation. If the expected population size is not achieved, the cycle of genetic recombination and random variation will repeat to produce more offspring until the quota for the main advantage level is filled. This strategy simplifies the acquisition of Pareto frontiers and simplifies the deployment of algorithms. In the field of community detection, this algorithm has significantly improved its ability to find the most favourable solution, thereby improving the accuracy of community pattern recognition. Therefore, this algorithm excels at revealing the most discriminatory community divisions.

In the field of refining CNN parameters, there are two main approaches for refreshing node labels: synchronous methods and asynchronous methods. Asynchronous methods involve parallel checking and adjusting the labels of nodes that have undergone modifications in both cycles, all of which are carried out during the iteration phase of the algorithm.

$$L_v \; t \; = f \; L_{v_1} \; t \; , \cdots , L_{vm} \; t \; , L_{v_{m+1}} \; t-1 \; , \cdots , L_{v_k} \; t-1 \tag{8}$$

In deep learning networks, digital images typically contain texture information of red, green, and blue. Similar to the spatial attention mechanism, channel attention also transforms images through convolutional layers to obtain new feature signals (or feature maps). Each newly generated signal can be decomposed into a component, and the contribution of different components to feature perception varies. They are usually used as a means to represent the correlation between each feature point and key information. The process of determining correlation based on the components provided by channel signals is called channel domain attention enhancement. Although the feature extractors of the model are not the same, the height and width of the new feature matrix usually contain the same content. The feature signal contains c channels, each of which is fed into global average pooling, excitation, and scale to obtain the weight values of each channel in the channel domain.

$$f \; x \; = \frac{\gamma^{'}}{\gamma} \tag{9}$$

In this case, $\gamma^{'}$ represents the level of support for newly established rules through genetic manipulation, while γ there is a preset limit on the acceptable level of support determined by the user.

4 RESULT ANALYSIS

4.1 Testing Platform

In order to measure the accuracy of our technology, we conducted a series of experiments on a variety of ICH-related image sets, covering Paper Cuttings, embroidery, wood carving, and other art forms. We divided these images into three groups: one for training, another for validation, and the third for testing. Our CNN model underwent training in the first group, fine-tuning and enhancement in the second group, and finally evaluated its effectiveness for the third group.

In the initial stage, we use genetic algorithms to adjust CNN parameters. This involves a comprehensive process of repetition and evolutionary selection, guiding us to find a set of parameters that perform best on the validation image. Through these optimized settings, we retrained the CNN model and tested it using test images. The subsequent results fully demonstrate the tremendous success of our method in the field of ICH digital replication.

All experimental procedures were conducted on a PC-based standard device, and Table 1 lists the complete environment for conducting these tests.

Structure	*Content*	*Parameter*
software	operating system	Windows 10
	development tool	OpenCV

structure	processor	Core i7
	Memory storage	16 GB
	Hard disk	1 Tb

Table 1: Running environment of the refactoring test platform.

Subsequently, correspondence testing of image elements on the selected flat image is performed to generate relevant test results.

4.2 Result Analysis

In order to evaluate the effectiveness of modelling and visualization teaching strategies for ICH projects using CAD technology in the real world, this study selected a series of representative ICH projects for testing. This study aims to highlight the superiority of the method described in this article by comparing its modelling accuracy and educational benefits with other teaching methods. The results of these comparative experiments are shown in Figure 4.

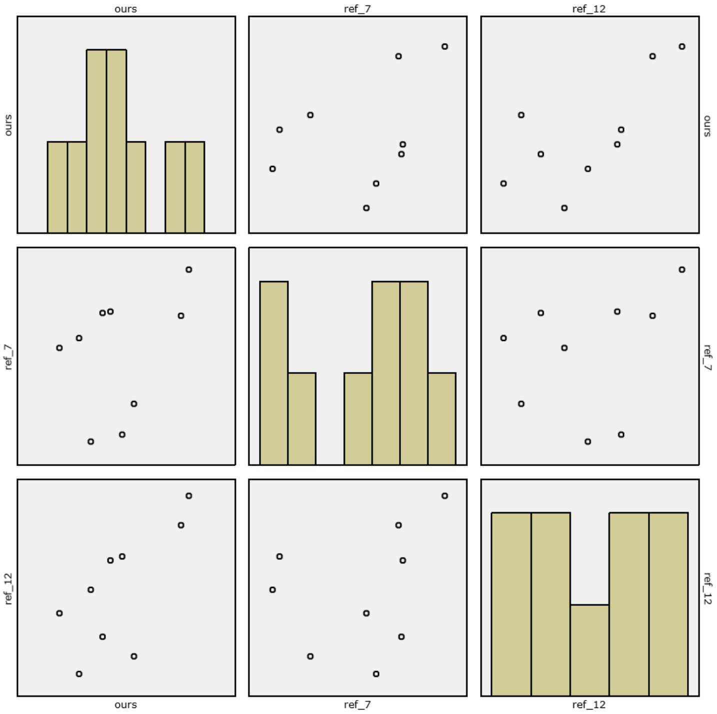

Figure 4: Comparison of modelling accuracy explanation.

The new ICH digital modelling technology using CNN introduced in this study has significantly better modelling accuracy than traditional methods. This progress is mainly attributed to the excellent ability of CNN in feature extraction, as well as the effective optimization of CNN parameters by GA.

On this basis, the study continues to evaluate the effectiveness of various methods within the education system, with a focus on students' understanding of ICH culture and their participation in the theme. The interactive learning system records the participation of students as an indicator for evaluating teaching effectiveness. The results of this analysis are shown in Figure 5.

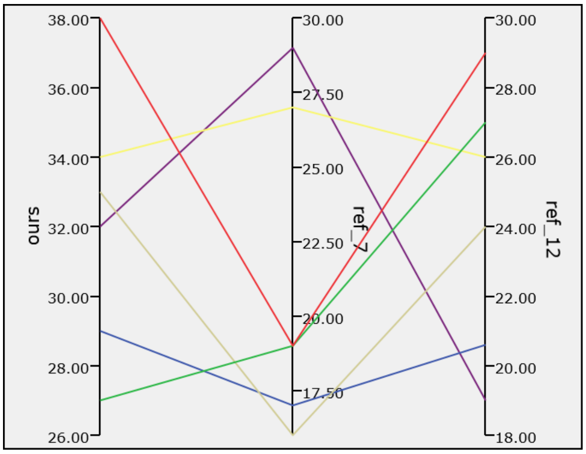

Figure 5: Cross-method education impact analysis.

The data shows that innovative visual teaching methods have increased student engagement, indicating a high enthusiasm for exploring ICH culture.

To comprehensively measure the efficiency of this method, the study also included 3D model reconstruction experiments. These experiments include comparing our technology with existing methods to evaluate the accuracy of reconstruction and user satisfaction. Figures 6 and 7 provide detailed explanations of the results of these experiments.

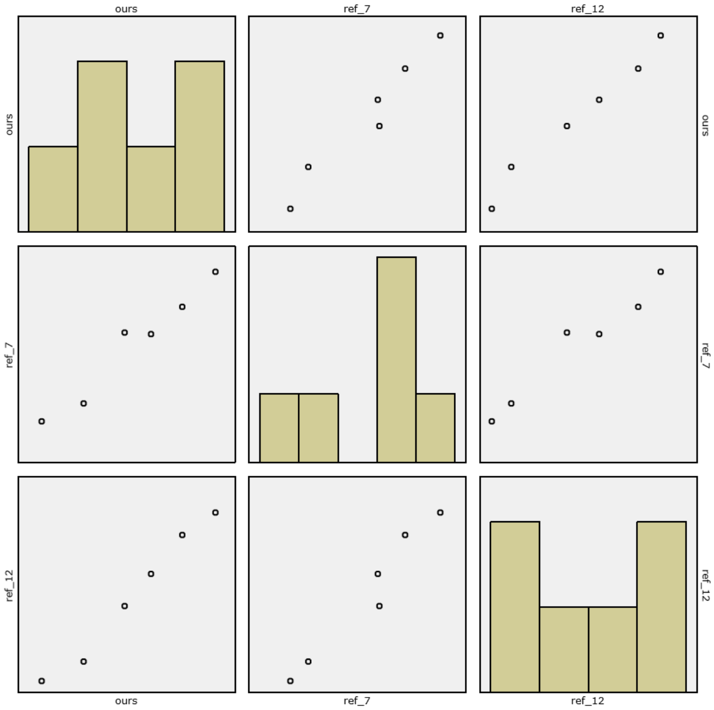

Figure 6: Analysis of reconstruction accuracy results.

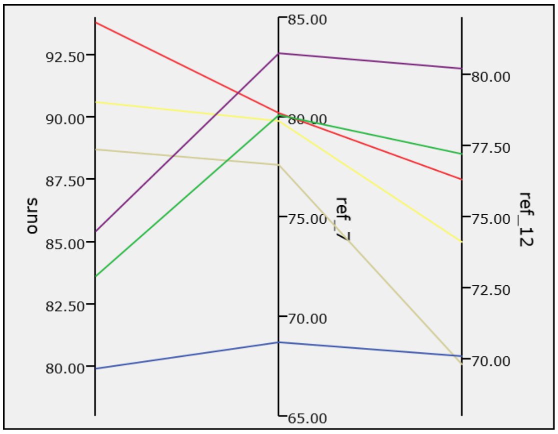

Figure 7: User satisfaction evaluation results.

Finally, the visual teaching system we developed was tested through image-matching experiments to demonstrate its practicality in the real world. The results of these experiments are shown in Figure 8.

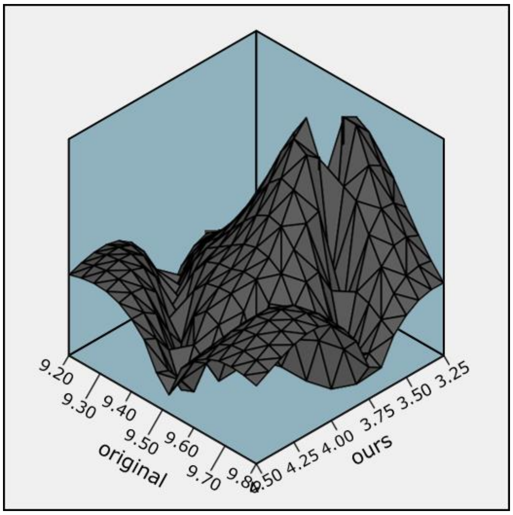

Figure 8: Analysis of image correspondence error rate.

The spatial domain attention mechanism processes the image features in each channel as the same data. Although the first two attention mechanisms can focus on feature information, they both have fatal flaws. Similarly, the channel domain attention mechanism calculates the spatial information within the channel as a fixed value, lacking the necessary spatial information to perceive texture features. This approach may result in channel signals being calculated as a fixed value rather than dynamic recognition during the image feature extraction stage. Therefore, a hybrid domain attention mechanism that integrates the advantages of the spatial domain attention mechanism and channel domain attention mechanism can play a greater role in the model. Feature-based matching methods have good robustness to changes in image rotation scale, lighting changes, and noise effects, and have low time loss, gradually becoming the most concerned image matching method. It uses feature descriptors to match the reference image and the image to be matched. In the reference image and the image to be matched, feature extraction is a necessary step before image matching based on features. No need to directly collect and process grayscale information of the image. By extracting features from the image and then describing these features.

5 CONCLUSIONS

This study delves into the digital representation and visualization-based teaching strategies for protecting ICH and proposes a new method for improving ICH digital models using CNN and GA. This method improves the accuracy and authenticity of the model, ensuring that the complex subtle differences and prominent features of the ICH project are faithfully reproduced.

It has been found that the integration of visual teaching systems significantly enhances students' understanding and enthusiasm for participating in ICH culture.

This study proposes an innovative and effective method for digital modelling and visualization technology. By analyzing the intangible cultural heritage of traditional teaching models, a new digital teaching technology has been constructed. Through a background investigation of traditional culture among students, a significant protection program for cultural connotations and artistic values has been constructed. This not only showcases the historical value of traditional culture but also enhances the national confidence of students in teaching. Looking ahead, we are committed to further improving and strengthening this method to better serve the ICH protection cause.

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Lanlan Zhang, https://orcid.org/0009-0007-9353-7745

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