Research Article

Research on Convolutional Neural Network-Based Virtual Reality Platform Framework for the Intangible Cultural Heritage Conservation of China Hainan Li Nationality: Boat-Shaped House as an Example

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Hainan is located at the southernmost tip of China, since ancient times it has always occupied an important position on the Silk Road. Hainan culture is dominated by minority and marine cultures and has a rich intangible cultural heritage. Hainan has always been committed to the development and utilization of its wide cultural heritage, and the development direction is mainly based on live display and folk activities. In May 2020, the Chinese government announced the establishment of the Hainan Free Trade Port Policy and System, the establishment of a Hainan International Free Trade Zone, and the development of tourism, modern services, and high-tech industry. All these put forward higher requirements for the protection of Hainan's cultural heritage, not just traditional ways to protect and promote, but also to use the dividends of current scientific and technological development to keep up with the times to protect and promote. The integration of digital technology will be the development direction of cultural heritage and intangible cultural heritage. This paper enumerates and analyzes other cases and academic directions of intangible cultural heritage, combined with the present situation of intangible cultural heritage in Hainan. It also analyzes the predicament of handiwork inheritance in Hainan intangible cultural heritage, expounds the structure, humanistic connotation, and construction skills of Li nationality ship house, and summarizes the role of a novel deep learning convolutional neural network- (CNN-) based virtual reality framework of intangible cultural heritage conservation in promoting the intangible cultural heritage of traditional skills. It also puts forward the scheme and heritage conservation virtual reality content construction and provides the process of building a virtual reality platform for the intangible cultural heritage of ship-shaped houses, which as an example can be used as a reference for intangible cultural heritage researchers in other areas. At the same time, it fills the gap for the artificial intelligence-based digitization of the intangible cultural heritage.

1. Introduction

In the protection of intangible cultural heritage, the digitalization of intangible heritage has become more and more common and has now entered a mature stage in technology [1], mainly focusing on digital collection, storage, protection, database resource construction, and the use of digital technology to achieve intangible cultural heritage protection and development. The system development and application of the digital development, protection, cultural creative products, and other aspects of cultural heritage-related technologies as virtual reality are also in a period of rapid development. China's digital research and practice is still in the stage of exploration, and there is a lack of a systematic solution to the research on the design and creativity of digital content for the public and the practicality of the communication platform. On the other hand, heritage images gathered from the Internet and sources are always blur and

of low quality. Before image processing, it is of great importance to process blur picture as input and obtain the sharp one at full resolution as output. The technique of sharpening blur image has more impact on heritage conservation. The construction of the CNNs VR platform framework is based on the research of the integration of the material cultural heritage and virtual reality technology in Hainan and South Africa. It uses deep learning image processing, computer graphics, digital animation, games design, and other digital arts and technical methods combined with the characteristics of shipbuilding technologies to design the content.

At present, China has made certain achievements in the digitization of material culture and intangible cultural heritage. The three items in Table 1 are the restoration of existing heritage, the reshaping of disappeared culture, and the AR conversion of intangible culture. The three projects are introduced, and the advantages and disadvantages of each project are analyzed.

China's effort in the protection of intangible cultural heritage has been continuously strengthened. From the social science and natural science levels, national research institutions have actively participated in the exploration and research of the protection of intangible cultural heritage. In terms of research on the fundamental issues of digitization of intangible cultural heritage, it is mainly reflected in the discussion of digitization issues such as digitization methods, digital collection, data storage, and database construction. Zhang and others [3] discussed about digital technology such as the role in the digital protection of digital collection, storage, restoration, reproduction, display, and dissemination of intangible cultural heritage. Rosa Tamborrino and Wendrich [4] proposed communication in information space in theory, where two issues of digitization of intangible cultural heritage content are discussed: information and information dissemination. Wang and Shen [5] proposed the urgency and necessity of the digitization of intangible cultural heritage. The example illustrates the ideas and methods of digital construction. Doulamis et al. [6] in their article discussed the integration of folk literature intangible cultural heritage and digital animation technology. Leimgruber [7] discussed the urgency and importance of the digital construction of art archives for the protection of nonheritage and proposed an art archive database: construction ideas in the field of digital research and development, utilization, display, communication, inheritance, and other issues. Teo [8], in his paper on "Research on Digital Modeling and Rendering Technology," mainly discusses the related digital modeling and rendering technology.

The research content of this article is divided into several aspects: (1) a brief analysis of the present situation of the intangible culture in Hainan is made and the six difficulties faced by the intangible cultural heritage are pointed out; (2) based on the shipbuilding technology of this article, three effects of virtual reality on the development of intangible cultural heritage are analyzed; (3) the status quo faced by the boat-shaped houses of the Li nationality is elaborated and the basic structure, classification, use of raw materials, and construction methods of the boat-shaped houses are analyzed in detail; (4) the system construction ideas of the deep learning CNNs virtual reality platform are analyzed, a virtual digital framework is constructed, the structural design of the virtual platform is carried out according to the characteristics of the ship-shaped house construction, and the combination of virtual reality and animation art is realized; and (5) the expected effect of the virtual reality platform is predicted and analyzed.

2. The Status Quo of the Intangible Cultural Heritage of the Li Nationality in Hainan

2.1. The Overall Status of Hainan Li People's Intangible Cultural Heritage.
Hainan Li nationality is the place where Hainan culture is concentrated. In the investigation of Li nationality, it is found that the culture of Li nationality contains the unique marine culture of Hainan and occupies an important position on the "Silk Road" of the South China Sea. In history, archaeologists discovered ancient tombs and funerary objects in the Han Dynasty in Ledong, Changjiang, Dongfang, and other places, and these places are also the places where the Li people live together [9]. By browsing the intangible cultural heritage network of Hainan Province, this paper analyzes the current situation of intangible cultural heritage resources in Hainan Province, in which the traditional spinning, dyeing, and weaving skills of the Li nationality are listed as a world-class intangible cultural heritage list. Another 12 intangible cultures are included in the national intangible cultural list, and there are 27 provincial intangible cultural heritages. Most of these intangible cultural heritages are distributed in Wuzhishan, Qiongzhong, and Baoting in the central part (Figure 1), covering 7 categories including traditional music, traditional dance, traditional drama, traditional art, traditional skills, folk customs, and others.

According to the general distribution of intangible cultural heritage in Hainan, Table 2 shows the classification of the intangible cultural heritage of Li nationality in Hainan.

2.2. The Status Quo of Li-Style Boat-Shaped Houses and the Exploration of Construction Skills

2.2.1. The Status Quo of the Boat-Shaped Houses of the Li Nationality.
With the development of society, Li villagers have gradually left their villages to make a living in big cities. The Hainan Provincial Government has built a brick house next to the original boat-shaped villages in 2010 for the sake of the modernization of Li villagers. Villager life: when I inspected the boat-shaped houses of the Li people in Hainan in 2013, Ocha Village, Dongfang City, Hainan Province, was the most well-preserved, largest, and most primitive Li village in the Li village. At that time, all but one of the residents had moved Xincun. Because the boat-shaped house is made of original materials and the construction process is relatively simple, the house will naturally collapse after three years or so without care. The original Li villages no longer exist (Figure 2).

TABLE 1: Three intangible cultural heritage digitization projects in China.

Project name	Project features	Advantages and disadvantages
Digital Dunhuang Mural Project	The project jointly carried out by the Dunhuang Research Institute and the Northwest University of the United States has collected 300 DPI precision collections of 10 dynasties, 30 caves, and 4,430 square meters of murals and established a website. You can use VR glasses to view 30 caves in a panoramic roaming form.	Advs: cross-regional communication, exquisite production, knowledge dissemination Disadvs: weak immersion, lack of interaction and fun
Digital Old Summer Palace Project	Since 1999, the team of Tsinghua University has spent 18 years reproducing the Old Summer Palace with the latest technological means such as computers and augmented reality technology. Launched a mobile APP; visitors can see the original appearance of the restored Old Summer Palace and its history through a handheld mobile device [2].	Advs: strong sense of immersion Disadvs: lack of interaction, local communication
AR Postcard	Foshan, Guangdong, China, launched a national-level intangible cultural heritage project with AR technology embedded on the basis of traditional postcards. Through digital technology, national intangible cultural heritages such as paper-cutting, wooden board new year pictures, Shiwan pottery craftsmanship, and Cantonese opera were displayed.	Advs: easy viewing and fast speed Disadvs: lack of interaction, immersion, and substitution

FIGURE 1: Approximate distribution map of the ICH of Hainan.

2.2.2. Basic Structure of the Li-Style Boat-Shaped House.
The traditional bamboo and wooden structure of traditional residential buildings in the Li ethnic area of Hainan resembles a boat that has been turned upside down, so it is called a boat-shaped house. When constructing a boat-shaped house, first a rectangular ground is arranged, natural and strong trunks are used as pillars supporting the roof beams, two eaves columns about half the height of the center column are used to support the eaves beam and then the center column supports the ridge beam, the semicircular arch coupons are placed on the spine beams, and then purlins and rafters are used to form a grid on the arch coupons. Finally, the woven materials such as sunflower leaves or thatch are used as the roof. The boat-shaped house of the Li nationality belongs to stilt-style architecture (dry hurdle architecture, that is, a building that rises above the ground on a wooden (bamboo) column under frame (Baidu Encyclopedia); compared with other ethnic minority dry-style buildings, it is relatively primitive in terms of modeling and construction skills, and its biggest feature is that it does not use tenon riveting in construction. Tong (s nm o) is the main structural method of ancient Chinese architecture, furniture, and other instruments and is a connection method that uses a combination of concave and convex parts on the two components. The convex part is called tenon; the concave part is called Mao (or tenon, groove). The connections between the boat-shaped house components are almost all tied together

with materials taken from wild hemp skin or rattan, and the various parts of the house are connected and fixed as a whole. The use of these plants with elastic rattan skins not only can strengthen the stability of the boat-shaped house but also play a role in resisting typhoon.

The structure of the boat-shaped house also has certain significance: there are three tall pillars in the middle of the thatched house. In the Li language, these three pillars are called "Goe," which means man. There are six relatively short columns standing on either side, called "Goding" in the Li language, which means woman. The nine pillars (pictured left) together represent the home made of men and women (Figure 3).

2.2.3. Classification of Boat-Shaped Houses of Li Nationality.
The life of the Li people is relatively simple, and the function of the boat-shaped house in which the people live is not complicated. It can be divided into three types based on the function and structure: the main house, the barn, and Long Gui (Table 3).

2.2.4. Raw Materials of Boat-Shaped Houses of Li Nationality.
The materials used to build the boat-shaped house are very simple, and there is no reinforced concrete, nor brick or tile. The materials used are original trees, bamboo poles that are now cut, dried thatched grass, and wild rattan. The villagers of the Li ethnic group in Hainan cut trees in July-September every year because at that time wood is clean and intact and there are few moths. Similarly, the choice of bamboo poles was also in winter. At this time, bamboo was rarely eaten by insects. The pillars and eaves of the boat-shaped house are generally made of high-quality wood, which is strong and neat. And the rafters mostly use fine-grained fruit trees, dense and resistant to moisture. Rattan and hemp skin are used as stable materials for binding, and there is no limit on the collection time. The grandpa and grandma of the Li nationality can cut down at any time. The wall is made of clay mixed with straw.

TABLE 2: Classification of the intangible cultural heritage of Li nationality.

Items	Name
Folk literature	Li folk tales
	Li congliu's song
	Li folk songs (qiongzhong li folk songs)
	Bamboo and wood instrumental music of Li nationality
	Li sai dialect long tone
Traditional dance	Li firewood dance
	Li qian ling double sword dance
	Li pound rice dance
	Li people dance together
	Li mask dance
	Li old dance
Traditional skills	Li traditionally dyed spun silk embroideries skills
	Li bark cloth-making skills
	Li bone ware-making skills
	The original pottery-making skills of Li nationality
	Li's skills of drilling wood and making fire
	Li ganlan construction skills
	Li boat-building skills
	Li rattan and bamboo weaving skills
	The craft of making single wood utensils of Li nationality
	Li jin spinning, dyeing, and embroidering tool-making skills
Traditional sports	Traditional sports and entertainment of Li nationality
Traditional medicine	Li medicine
Traditional custom	"March 3rd" festival of the Li and Miao nationalities in Hainan
	Li clothing
	Li traditional wedding
	The custom of crossing the river by Yao boat

FIGURE 2: The rapidly ruined boat-shaped house of the Li nationality (investigated in Ocha Village, Dongfang City, Hainan Province).

FIGURE 3: The pillar structure of the boat-shaped house of the Li nationality (three in the middle symbolize males and six on both sides symbolize females).

2.2.5. Skills of Building Li-Style Boat-Shaped Houses. It is integrated into the architectural concept that although the materials used to the craft of building a boat-shaped house are very simple, the resulting house is nevertheless original. The villagers first laid clay on the ground, poured appropriate water, and stepped on it evenly, waiting for the ground to become hard; at the same time, the carpenters of the Li nationality made logs to support the pillars of the roof beam; the old people of the Li nationality were responsible for making the pillars, pruning bamboo poles, and preparing long thatched roof.

The craftsmen built the roof into an arch to resist the typhoon and also facilitate drainage. After building the complete frame, laid the woven thatched sheet on the arched roof. These thatch pieces are about 2 meters long and 1.3 meters wide, and the thatch extends as far as possible to the ground because the rain can flow along the thatch without wetting the wall, and there is a danger of collapse. The 300 pieces of thatch are not simply stacked on the pergola, but the pergola is used as the bottom layer of the roof. After fixing the beams, according to the S-shaped trend, choose to start from the eaves on any side, overlap each two pieces of thatch first part, and then fix the precut rattan on the pergola, from left to right, and then slowly move up from the other side, from right to left, so repeat; you can complete the laying of the arched roof.

For the construction of the wall surface, first use bamboo poles and branches to build a frame and then use clay straw mixed with straw to form a wall, so that the wall of the boat-shaped house is completed (Figure 4). There are double front and rear doors on the wall and no windows. Perhaps, the traditional superstitious ghosts of Li ancestors would enter

TABLE 3: Basic types of Li boat-shaped houses.

| Boat-shaped house classification		Structure and function	Icon
Main house	Integrated single room type	Consists of living room and front porch terrace. There is no wall partition in the living room, and all the living, dining, and debris are all in one room.	
	House type with separate living room and storage room	There is a clear division of labor in residential life. In simple terms, in addition to the living room, a small warehouse is added to store dry firewood, clay pots, and other items, in addition to several poultry.	
	Multiroom boat-shaped house	In addition to the small warehouse, the daily living area and living area are carefully divided, including the front porch drying platform, the main room, and multiple living rooms.	
Barn		Where the villagers store grain, the barn does not directly touch the ground, and it is built with a stone pad and a certain height. It can be ventilated and protected from moisture and insects and rodents. A layer of clay and mud will be pasted inside and outside the barn walls and even the floor must be pasted. A thick layer of mud has a good sealing effect.	
Long Gui		Long Gui is generally located in a secluded place in the village. In modern times, the village is built to provide a place for love and love for married men and women. Historically speaking, Long Gui is the woman's long-term residence. According to the residence rules of the Li nationality, married women can stay in their husband's homes, and they can still live in the premarriage boudoir. Therefore, Long Gui is full of primitive romantic sex, and it also reflects that the Hainan Li culture retains the basic characteristics of the maternal clan.	
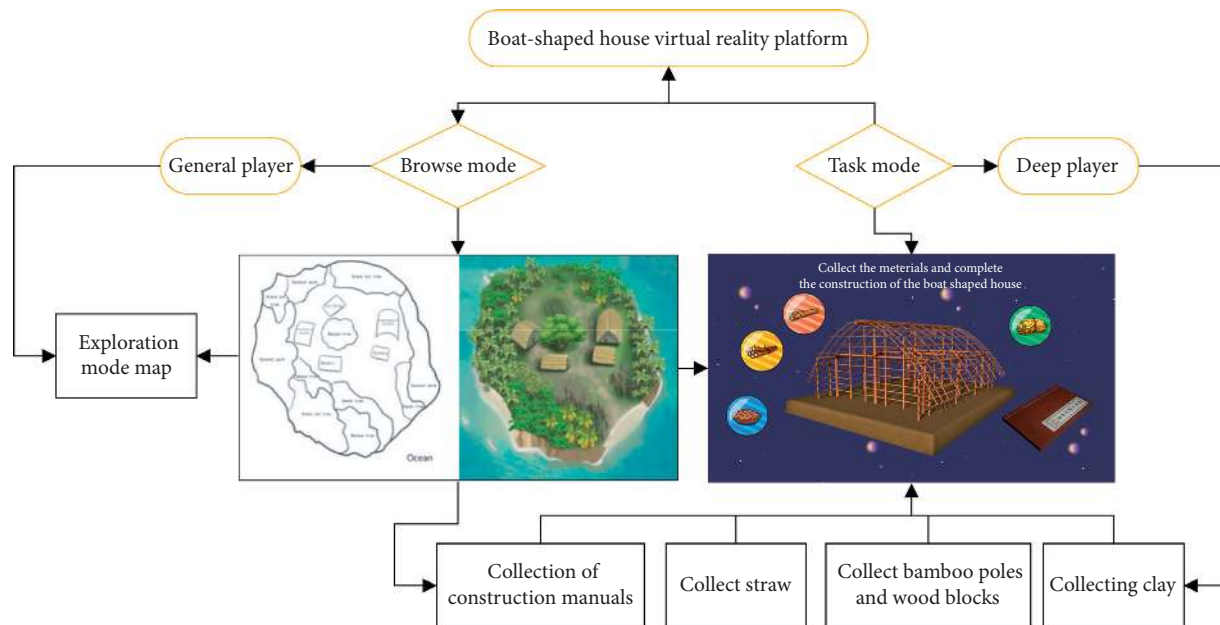
FIGURE 4: The completion model of the audience of the virtual reality platform of the boat-shaped house.

through the windows. From the perspective of modern architecture, because the boat-shaped house is built in the deep mountains, no windows are provided to prevent wind and avoid beasts. The disadvantage is that the house is dim and inconvenient for lighting and ventilation. According to the old people of the Li nationality, a boat-shaped house can

now be built in as fast as three days. Thanks to the advancement of tools and the evolution of working methods, it took months to build a boat-shaped house in the past.

2.2.6. Blurred Li-Style Boat-Shaped House Restoration. As image derived from old times and from Internets is always with low quality, for the Li culture reservations, a novel deep learning convolutional neural network- (CNN-) based virtual reality framework is introduced in this study. Blue image deconvolution is an ill-posed problem [10–13] addressed by the regularization methods. The wavelet transform [14–17] is an effective denoising method related to regularized inversion. In this study, wavelet transform is utilized to decompose and extract the low- and high-frequency information of the blurred image, which is taken as the critical step of the presented deblurring methods. However, when the process highlights the approximate portion of the image feature, the blurry image will be smoothed so that the image is distorted. Simultaneously, the overall wavelet transform will result in excessive data redundancy for the image. Thus, based on the recursive CNN, a deep recursive CNN is designed, which can eliminate or weaken the characteristics of high data redundancy and image smoothness caused by wavelet transform to remove the blur of the corrupted image. Comparing with the traditional convolution neural network in image restoration, deep recursive CNN has better performance in deblurring with fast training speed. Thereafter, a novel loss function is built to attain the best deblurring effect of the proposed method based on the L2 regularization term. The experiment results in the next section demonstrate that our method has practical applicability for image restoration with different blurs, such as the motion blur, Gaussian blur, and out-of-focus by camera.

3. Construction Scheme of Virtual Reality Platform for Building Craftsmanship of Li Nationality

3.1. The Design Concept and Structure of the Platform. Grau [18], from perspective paintings, panoramic paintings, and movies to virtual reality, "shows the extraordinary efforts made by human beings to create the maximum illusion space using various technical means in various periods of history". Li [19] realizes the development of intangible cultural heritage in the form of virtual reality. Its main purpose is to promote the local intangible cultural heritage. The use of virtual reality technology allows people to be immersed in the Li nationality environment and let people feel that they are in art space to understand the intangible heritage is the main purpose of this platform design. For different heritages, we need to set up different environmental spaces, different interaction methods, and different game main lines to adapt.

This study first collates the intangible cultural heritage of Hainan, with deep learning CNN image restoration technologies; we successfully enumerate each idea of intangible cultural heritage digitization and how to realize it, so as to form a systematic and integrated digital development framework. Boat-shaped house is used as the research object example, and the local residents were interviewed according to the construction technology of the boat-shaped house to find local materials, copy records, and simulation creation through text, images, audio, and video.

Classify and sort out the documents, pictures, audiovisual materials, [20] etc., and digitally model, restore, and classify the places and props where people live in Li villages. According to the on-the-spot investigation and survey, the boat-shaped house construction technology [21] is finally displayed to users through virtual reality animation and virtual reality interaction (Figure 5).

In the above, we saw that most virtual reality projects, such as the Digital Dunhuang Project, display cultural heritage in the form of scene roaming. The advantage of this is the freedom of display, i.e., the public can choose to visit independently, more exquisite in the picture, and handling the details more accurately and meticulously. Its shortcomings are lack of interaction with the audience, the attraction to the audience will be reduced, and the durability is insufficient. In the game, there is a concept of flow based on social experience and user perception test [22]. It is relatively difficult for players to enter the flow level, which is affected by factors such as environment, attention, control, and understanding. But at least we can provide the possibility to enter the flow state in terms of environment and operation. Based on the research on the theoretical basis of the flow of games, we added the concept of games to the virtual reality platform of the Li boat-shaped house, adding games and interaction to interactively display the intangible cultural heritage. On the platform structure, we divided into two parts according to the characteristics of the audience:

(1) For general groups who are just viewing and understanding, the platform sets up a tour mode to open as much content as possible for them to visit, so as to understand the living environment of the Li nationality; in the planning of the Li village, we divided the village into several areas: large boat-shaped house (house for family living), a barn (a house for storing grains), a long boudoir (a house where the married woman lives alone) and various tropical plant areas such as betel palm area, coconut tree area, kapok area, banana tree area, etc., topographic map). Different adventure contents are set in these areas to increase the player's fun.

(2) For those who have a certain game foundation, have more interactive needs, and have a sense of accomplishment after completing the task, we have set up some task-based contents in the system, such as looking for various materials to complete the boat-shaped house put up. Inspire the audience's flow induction through the completion of the task. In the form of village exploration, let tourists or players enter a Li village and use the guidance of the characters in our scene to find various props to build a boat-shaped house: boat-shaped house construction secrets, soil, straw, bamboo poles, and wood to
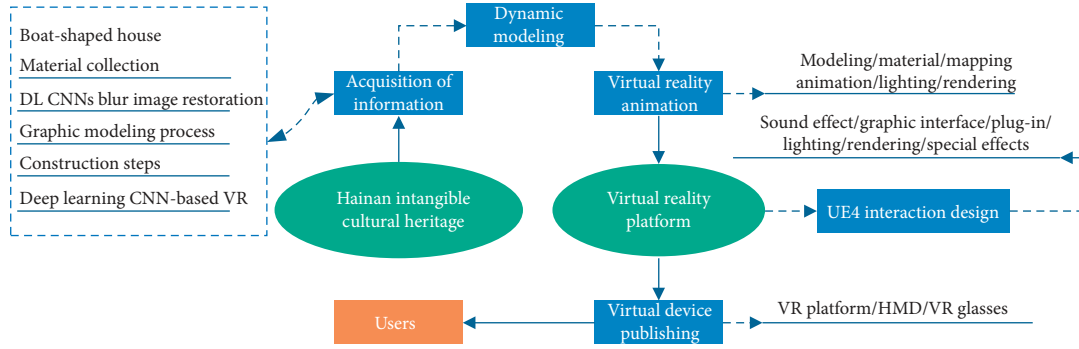
FIGURE 5: Virtual reality flowchart of Hainan intangible cultural heritage.

complete the boat-shaped house construction work. When the collection of props is complete, there will be a complete boat-shaped house construction process demonstration and an interpretation of the cultural connotation of the Li nationality contained in the boat-shaped house (Figure 4).

Through the two-way selection of content structure, the audience can understand the living environment of Li people, the dwelling place, the reason and technology of the construction of the boat-shaped house, and the living habits of Li people through virtual reality, so as to gain a deeper understanding of the Li people and their nonmaterial cultural heritage.

3.2. CNNs Deep Learning Encoder for Blur Boat-Shaped House Image Fast Convergence.

For Li nationality boat-shaped house heritage conservation, considering dataset, it is always good to do image deblurring along with a realistic dataset by clicking consecutive frames from videos which are taken by a handheld camera for getting accurate results. We use a house dataset downloaded from GitHub which consists of 2000 blur/sharp image house pairs. The dataset will be split into training and testing data. Training data contain 1500 blur/sharp images at high resolution and testing data contain 1000 blurry images. We preprocess the blur/sharp images using Keras image data generator. The images in the dataset have 256×256 pixel resolution.

Regarding deep learning, our deblurring CNNs are derived from LeNET introduced by Yann LeCun, a researcher at AT&T Bell Labs, for the purpose of recognizing handwritten digits in images [23]. The algorithmic program employed through Python enabled PyTorch. The framework has differing types of hidden layers, and CNN generally comprises input layer, convolutional layers, pooling layers, absolutely connected layers, and output layer.

The convolution layer is mainly used for feature learning. Feature learning is a collection of technologies that transform raw data into a technology that can be effectively developed by machine learning. The goal of feature learning is not to predict an observation by learning the original data but to learn the underlying structure of the data, so that other characteristics of the original data can be analyzed. Compared with the classical neural network model,

convolution neural network is no longer a limited one-dimensional input mode that can only read or receive expression, and it can better receive information to express richer two-dimensional data structure or multidimensional data structure. This two-dimensional matrix data structure is also called feature graph in the research work of CNN. Each convolution kernel can output a feature graph, and a series of input feature data are calculated by the convolution kernel, and then an output feature graph can be obtained after averaging the results. The calculation formula is as follows:

$$X_j^l = f\left(\sum_{i \in M_i}\left(X_i^{l-1}\right) * W_{ij}^l + b_j^l\right). \tag{1}$$

where M_j represents the input training set, X_j^l represents the j-th feature map of the l-th layer, X_i^{l-1} represents the i-th feature map of the $l-1$ layer, and $*$ represents the convolution.

In general, the image matrix and the convolution kernel are square matrix. If the size of the image matrix is w, the size of the convolution kernel is k, the moving step is s, and the number of zero-padding layers is p, then the size of the characteristic graph produced by convolution is given by

$$w' = \frac{w + 2p - k}{s} + 1. \tag{2}$$

The main function of the pooling layer is to aggregate the feature information of the upper layer and represent the feature information in the window as a feature. This kind of calculation is equivalent to the reduction and fusion of features, avoids network overfitting, and improves the generalization ability of the network model. Because the pooling operation only extracts the main feature information in the pooling domain, some of the information will be lost more or less. The larger the sliding step of the pooling window, the more information will be lost. The calculation formula of pooling is shown as follows:

$$y = \text{pool}\left(x_{i,j}\right), \quad i, j \in p, \tag{3}$$

where x_{ij} represents the elements in the pooling area p in the input of the pooling layer and pool() represents the pooling operation, in which pooling operation generally chooses the maximum pooling or average pooling, that is, the maximum

or average value in the upper output characteristic graph in the pooling window is taken as the final output result.

The mode of connection of neurons in the fully connected layer belongs to the form of dense connection, that is, the fully connected neurons are connected to each neuron in front of them. It is generally located at the top of the convolution neural network structure. Its function is to abstract the output features of the front layer, and this abstract expression is the whole of the features. The expression of the full connection layer is shown as follows:

$$h(x) = \delta\left(W^T x\right) = \delta\left(\sum_{i-1}^{n} W_i x_i + b\right), \qquad (4)$$

where x_i is the input, $h(x)$ is the output value of the fully connected operation, δ is the activation function, W_i is the weight of the i parameter in the fully connected layer, b is the offset in the fully connected layer, and n represents the number of parameters in the fully connected layer.

$$\delta_j^{(l)} = \frac{\partial J}{\partial z_j^{(l)}} = \frac{\partial J}{\partial a_j^{(l)}} \frac{\partial a_j^{(l)}}{\partial z_j^{(l)}} = \beta_j^{l+1} \left(f'\left(z_j^{(l)}\right) \cdot \mathrm{up}\left(\delta_j^{(l+1)}\right)\right). \quad (5)$$

In the process of learning and training the convolutional neural network, the whole network carries out feature extraction through forward propagation, and then the whole network modifies and adjusts the weights in the network structure through backpropagation.

The network parameters W and b in forward propagation are obtained through training. Suppose there is a training set of m elements $(x^{(1)} y^{(1)}), \ldots, (x^{(m)}, y^{(m)})$. Then, for a single training sample x through the multilayer neural network, the output is $h_{W,b}(X)$. Its loss function $J(W, b, x, y)$ is given by

$$J(W, b, x, y) = \frac{1}{2}\left\|h_{W,b}(x)\right\|^2. \qquad (6)$$

For m elements, the total loss function is defined as follows:

$$J(W, b) = \left[\frac{1}{m}\sum_{i=1}^{m} J\left(W, b, x^{(i)}, y^{(i)}\right)\right] + \frac{\lambda}{2}\sum_{l=1}^{n_l-1}\sum_{i=1}^{s_{l+1}}\sum_{j=1}^{s_l}\left(W_{ij}^l\right)^2, \qquad (7)$$

where n_l is the number of layers and s_l is the number of nodes in the l-th layer. The first term in the above formula is the average sum of squares of the squared error term, and the second term is the weight attenuation term. Its purpose is to prevent overfitting. The coefficient λ is mainly to adjust the weight ratio of the two.

The training sample (x, y) is input into DCNN and the corresponding actual output O is calculated and its expression is given by

$$O = F_n\left(\cdots\left(F_2\left(F_1\left(xW_1\right)W_2\cdots\right)W_n\right)\right), \qquad (8)$$

where F can be expressed as

$$x_j^l = f\left(u^l\right) = \frac{1}{1 + e^{-u}},$$
$$u^l = \sum_{i \in M_j} x_j^{l-1} \cdot w_{ij}^l + b_j^l, \qquad (9)$$

where l is the convolution layer and w and b are the convolution kernel and bias, respectively. The downsampling layer pooling formula is given by

$$x_j^{l+1} = f\left(\beta_j^{l+1}, \mathrm{down}\left(x_j^l\right) + b_j^{l+1}\right). \qquad (10)$$

Among them, down $(\cdot)$ is the downsampling function and β and b are the multiplicative and additive biases, respectively.

The main purpose of neural network training is to make the objective function $J(W, b)$ with independent variables W and b gradually decrease. The neural network uses the gradient descent method to update W and b, and the iteration direction is taken as the negative gradient direction, namely, $J(W, b)$. The calculation formula is

$$W_{ij}^{(l)} = W_{ij}^{(l)} - \eta \frac{\partial J(W, b)}{\partial W_j^{(l)}} = W_{ij}^{(l)} - \alpha\left(\alpha_j^{(l)}, \delta_i^{(l+1)}\right),$$
$$\qquad (11)$$
$$b_i^{(l)} = b_i^{(l)} - \eta \frac{\partial J(W, b)}{\partial b_i^{(l)}} = b_i^{(l)} - \alpha\delta_j^{(l+1)},$$

where η is the learning efficiency; $i = 1, 2, \ldots s_{l+1}$; $j = 1, 2, \ldots s_l$; the residual calculation formula of the activation value is given by

$$\delta_i^{(n_l)} = \frac{\partial J(W, b; x, y)}{\partial z_i^{(n_l)}} = -\left(y_i - a_i^{(n_l)}\right) \cdot f'\left(z_i^{(n_l)}\right),$$
$$\qquad (12)$$
$$z_i^{(n_l)} = \sum_{k=1}^{s_l} W_{ik}^{(n_l-1)} a_k^{(n_l-1)} + b_i^{(n_l-1)}.$$

Among them,

$$a_i^{(n_l)} = f'\left(z_i^{(n_l)}\right). \qquad (13)$$

The formula for calculating the residual error of the i-th node in the l-th layer is

$$\delta_i^{(l)} = \left(\sum_{j=1}^{s_{l+1}} W_{ji}^{(l)} \delta_j^{(l+1)} f'\left(z_i^{(l)}\right)\right). \qquad (14)$$

In the process of forward operation, each layer of the convolution neural network will perform different functions. In the convolution layer, the preprocessed sample data are convoluted with the corresponding convolution kernel to get the characteristic graph. The formula for calculating the weight update of the convolution layer, such as formula (1), is related to whether the fully connected layer or the lower sampling layer is connected behind it. If it is followed by the fully connected layer, it is necessary to know the error sensitive term $\delta_j^{(l)}$ of the fully connected layer, and its sensitive error term adopts a gradient descent algorithm

similar to that of the BP network. If the connector behind the convolution layer uses the layer, because the error sensitive term of the convolution layer 2 needs to be obtained through calculation, the neural network researchers usually perform *UnPooling* operations in the lower sampling layer of layer $l + 1$:

$$\frac{\partial J}{\partial k_{ij}^{(l)}} = \frac{\partial J}{\partial z_j^{(l)}} \frac{\partial z_j^{(l)}}{\partial k_{ij}^{(l)}} = \sum_{u,v} \left(\delta_j^{(l)}\right)_{u,v} \left(p_i^{l-1}\right)_{u,v},$$

$$\frac{\partial J}{\partial b_j^{(l)}} = \frac{\partial J}{\partial z_j^{(l)}} \frac{\partial z_j^{(l)}}{\partial b_j^{(l)}} = \sum_{u,v} \left(\delta_j^{(l)}\right)_{u,v}. \tag{15}$$

The $(a_{i}^{l-1})_{u,v}$ here is the block convoluted with $z_j^{(l)}$ selected in $a_i^{(l-1)}$ in order to get the position element of (u, v) of $k_{ij}^{(l)}$.

Formula (16) represents the loss function of a picture, where i represents the indication of the anchor in the mini-batch and the target detecting probability. Assuming that the anchor is a positive label, the predicted probability of GT is positive. Assuming that the anchor is a negative label, the predicted probability of GT is 0. Formula (17) represents the log loss function of the target type and the nontarget type. In formula (18), R represents the stable performance of the loss function in the Fast R-CNN algorithm and use formula (19) to describe the following:

$$L(pi, ti) = \frac{1}{N_{\text{cls}}} \sum_i L_{\text{cls}}(pi, pi^*) + \lambda \frac{1}{N_{\text{reg}}} \sum_i pi^* L_{\text{reg}}(ti, ti^*), \tag{16}$$

$$L_{\text{cls}}(pi, pi^*) = -\log\left[pi^* pi + (1 - pi^*)(1 - pi)\right], \tag{17}$$

$$L_{\text{reg}}(ti, ti^*) = R(ti - ti^*), \tag{18}$$

$$\text{smooth}_{L1}(x) = \begin{cases} 0.5x^2, & \text{if}|x| < 1, \\ |x| - 0.5, & \text{otherwise.} \end{cases} \tag{19}$$

Linear transformation: only normalizing the input may change the original characteristics or distribution of the input. For example, adding a batch normalization algorithm to the sigmoid function may change the input from non-linear to linear. In order to solve this problem, the learnable parameter gain γ and bias β can be used to fit the original distribution:

$$y^k = \gamma^k \cdot x^* + \beta^k. \tag{20}$$

When $y^k = \text{Var}[x^k]$ and $\beta^k = E[x^k]$, theoretically the same distribution as the input can be obtained. At the same time, BN allows a higher learning rate. Generally speaking, a larger learning rate will increase the size of the parameters when updating, which may cause the model to explode. However, after using the BN algorithm, the backward propagation of the network layer is not affected by the scale of the parameters, so it has no effect on *Jacobian* and gradient propagation, that is,

$$\frac{\partial B\ N(Wu)}{\partial u} = \frac{\partial B\ N((aW)u)}{\partial u},$$

$$\frac{\partial B\ N((aW)u)}{\partial a\ W} = \frac{1}{a}\frac{\partial B\ N(Wu)}{\partial W}. \tag{21}$$

It can be seen from the equation that the gradient decreases when the weight w increases. Weight normalization (WN) chooses to rewrite the parameters of the weight vector W of the neural network. The parameterized weights improve the optimal condition to accelerate convergence. It is inspired by the batch normalization algorithm, but it is not like batch normalization. The unified algorithm also relies on the batch size, does not add noise to the gradient, and has a small amount of calculation. Weight normalization is successfully used in LSTM and noise-sensitive models such as reinforcement learning and generative models. The operation formula for normalizing the weight W of the deep learning network is as follows:

$$w = \frac{g}{\|v\|}v. \tag{22}$$

In order to solve the internal covariance change (ICS), another idea is to fix the mean and variance of each layer output, that is, the layer normalization algorithm (layer normalization, LN). The layer normalization algorithm uses the mean and variance of each sample to normalize the input. LN operates on a single sample and can be applied to small batches and RNNs. LN and BN have the same form, but different normalization methods. The difference between layer normalization and batch normalization algorithms is only in the way of obtaining statistical values. The following formula is the calculation method of mean and variance in the layer normalization algorithm, and H represents the number of hidden units in the layer.

$$u^l = \frac{1}{H} \sum_{i=1}^{H} a_i^l \sigma^l = \sqrt{\frac{1}{H} \sum_{i=1}^{H} \left(a_i^l - u^l\right)^2}. \tag{23}$$

For a test sample x, the batch normalization operation in the final test stage is as follows:

$$y = \frac{\gamma}{\sqrt{\text{Var}[x] + \varepsilon}} \cdot x + \left(\beta - \frac{\gamma E[x]}{\sqrt{\text{Var}[x] + \varepsilon}}\right). \tag{24}$$

Here, in convolution and pooling layers, ReLU is employed as activation function. Figure 3 illustrates our data flow algorithm based on LeNET. The input is a 256×256 image, and the output is the predicted image after deblurring deep learning (Figure 6). In the neural network of Figure 6, its hidden layer consists of convolution layer, pooling layer, and full connection layer. The blurred image is first processed by the convolution layer. In the convolution layer, each neuron in this layer is connected to the corresponding local receptive domain of the upper layer, and the local receptive domain features of the blurred image are extracted by filter and nonlinear transformation. Then, the features obtained from the convolution layer are pooled. In the pooling layer, the dimension of the fuzzy image extracted
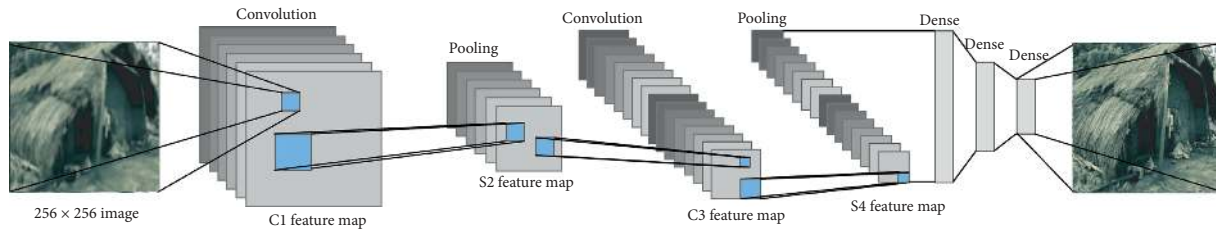
FIGURE 6: Data flow algorithm with the input of a 256×256 house blur image.

from the convolution layer is reduced, and the antidistortion ability of the model is increased at the same time. Then, the feature of the picture goes through the full connection layer to the last output layer, and the output layer mainly classifies and outputs the features obtained from the full connection layer, and finally, the corresponding clear picture can be output.

The convolution process operates on signals or pictures during which one is taken as sign or image, and also the alternative referred to as the kernel is taken as a filter on the input image, manufacturing an output image. It takes 2 pictures as input and produces a 3rd as output. In common man terms, the sign is taken and a filter is applied over it. This filter multiplies the sign with the kernel to induce the changed signal. In the case of image process, the kernel slides over the entire image so it changes the worth of every element of the image.

For the deep learning CNNs image trainings, the pooling process is a sample-based discretization method. Pooling is employed to down sample an input image, reducing its spatiality and leaving assumptions to be created regarding options contained within the subregions binned. There are unremarkable 2 varieties of pooling referred to as group and min pooling. Group pooling is defined as the substitution of the complete sample with the most prices from the chosen region and min pooling is defined as the substitution of the complete sample with the minimum price from the chosen region. Thus, our deep learning CNN is largely a deep LeNET that consists of hidden layers having convolution and pooling functions in addition to the activation function ReLU. Flattening is a straightforward step which straightens the element map put away in succession of numbers. This permits data to turn into the info layer of a manmade neural system for additional handling. The fully connected layer can be a customary multilayer perception. It utilizes grouping in the yield layer. Characterization is typically a softmax initiation work completely associated implies that every neuron in the past layer interfaces with every neuron. Softmax gets values between zero and one and adds them to one (100%). Softmax takes a vector of execution scores into a vector of qualities between zero and one. Dropout layer in deep learning is a technique to overcome the problem of overfitting. The dropout method takes a float number between 0 and 1. This value indicates ignoring a certain set of neurons while training to avoid overfitting. Batch size is simply how many training examples were taken for one forward and backward pass. But the increase in batch size makes the memory full and it takes more time for the process to complete.

The activation function in the convolution neural network is mainly used to nonlinearly transform the output results of each layer in the convolution network, so that the network model has a variety of nonlinear expression capabilities. Common activation functions are sigmoid, tanh, and ReLU. The sigmoid function is also called the *logistic* function, and each neuron, node, or activation entered is scaled to a value between 0 and 1, which is defined as follows:

$$f(x) = \frac{1}{1 + e^{-x}}. \tag{25}$$

Sigmoid is a smooth ladder function, which mainly has the following defects:

(1) It may cause the gradient to disappear when the gradient is backpropagated

(2) The analytical formula contains power operation, which is time-consuming to solve by computer

(3) The sensitive interval of the function is short, and it is not symmetrical about the center of the origin

The tanh function is used in the neural network after the sigmoid function, which is defined as follows:

$$\tanh(x) = \frac{e^x - e^{-x}}{e^x + e^{-x}}. \tag{26}$$

The effect of tanh function is very good when the feature difference is large, and the feature effect will be continuously expanded in the process of network propagation. The difference from sigmoid is that the origin is centrally symmetrical, but there is still nothing we can do about the problem of gradient disappearance. ReLU function can solve the gradient dissipation problem of backpropagation algorithm in optimizing the deep neural network to a great extent.

ReLU is the corrected linear measure that uses activation function. It gives zero for any negative pixel value; similarly, it gives the same value for any positive pixel value and is formulated as follows:

$$f(x) = \max(0, x), \tag{27}$$

where $f(x)$ is a function.

The ReLU function is actually a piecewise linear function, which turns all the negative values into zero while the positive values remain the same, and this operation is called unilateral suppression. It is precisely because of this unilateral inhibition that the neurons in the neural network also have sparse activation. The sparse model realized by ReLU can better mine the relevant features and fit the training data.

When the ReLU activation function is backpropagated, the gradient can be avoided.

Compared with other activation functions, ReLU has the following advantages: for linear functions, ReLU is more expressive, especially in deep networks; for deep networks, the gradient disappears easily when sigmoid functions are backpropagated. For the nonlinear function, because the gradient of the nonnegative interval of ReLU is constant, there is no problem of gradient disappearance, it keeps the convergence rate of the model in a stable state, and compared with sigmoid activation function and tanh activation function, the derivation of ReLU activation function is simple, which can reduce a lot of computation. Therefore, the ReLU function is used as the activation function of the convolution neural network in the experiment.

Hyperparameter selection such as training epoch is of great importance to produce improved image results. Thus, epoch number is the forward and backward pass on all the training data or simply completes an iteration. We also integrate hyperparameter optimization process using Ray tune for pruning hyperparameters including batch size, data count, and epoch. In the experiments, the images are loaded and converted into an array of pixels. The loaded images are sent through an encoder wherever convolution and pooling in addition to ReLU activation function are applied and the image is downsampled. The original house image can be converted back to the previous size in the decoder section. The model is compiled and fitted by shaping epochs and the learning rate is reduced. Intensive training and verification are also carried out to test our implemented LeNET CNNs algorithm, In Figure 7, we present deblurring training results with different metrics for measuring the changes in input blur house images.

3.3. The Graphical Modeling Process of the Boat-Shaped House.
After the restoration of blur and old images, virtual reality techniques are used through computer simulation to generate a three-dimensional space, providing users with visual, auditory, tactile, and other sensory simulations, so that users can observe things in the three-dimensional space in an immersive and timely manner without restrictions. It includes real-time 3D computer graphics technology, wide-angle (wide-field) stereoscopic display technology, tracking technology for user's head, eyes, and hands, as well as tactile feedback, stereo, network transmission, voice input, output technology, etc. [24].

The modeling of the hull-shaped house used the C4D polygon modeling method, which basically restored the original appearance of the hull-shaped house. Using polygon modeling not only helps to control the number of fundamentals of the hull model but also can create many details required for the target effect. The boat-shaped house is mainly divided into the modeling of walls, columns, windows, wooden doors, roofs, and floors. In addition to the pillars and roof structure using the scaling and extrusion of the columns to meet the requirements, the walls and floors are all through

Figure 7: Training results after 20 epochs, 40 epochs, 60 epochs, 80 epochs, and 100 epochs.

chamfer. It is handled by a smooth cube, the windows and doors are correspondingly spaced out on the wall, and then the built model has "mosaic" inside. Try to make the boat-shaped house model as a whole natural and historical house.

The use of virtual reality technology is to enable the audience to experience the construction process of the boat-shaped house even if they are not in the Li village. The UE4 engine is used in virtual interaction production. UE4 is a game engine developed by Epic Games. Game engines are the core components of editable computer game systems or interactive real-time image applications that have been written. These systems provide game designers with a variety of tools needed to write games, and the aim is to enable game designers to make game programs easily and quickly without having to start from scratch. UE4 engine is widely used in 3D modeling rendering and game development. Through the restoration of the three-dimensional animation model and the virtual interactive production of the virtual UE4 artificial intelligence engine, the construction process of the boat-shaped house is shown in Figure 8.

Unreal Engine is the core of virtual reality platform construction and the best choice for exploring VR technology. The production process such as 3D modeling and animation demonstration is for them. The ship model is imported into UE4, lighting and environmental atmosphere are adjusted, and then the operation blueprint is added to achieve interaction. During the production, real-time rendering based on Unreal Engine can be checked at any time. First, we loaded the VR device HTC + VIVE to UE4 and then checked the effect of virtual Li village through the SteamVR plug-in, and secondly, we created a game model, then created a new Pawn to set the headset to control handle, and added the camera and handle controller. Through the combination of a series of computers and VR technology, the virtual Li Village can achieve the initial expected effect in the engine. More importantly, the boat-shaped house construction skills can be fully demonstrated. There are already built and being built in the virtual Li Village. The boat-shaped house is surrounded by some tropical plants such as kapok, coconut tree, banyan tree, and jackfruit tree, as well as beautiful background music of flying butterflies, and the original ecological scene is in our eyes (Figure 9).
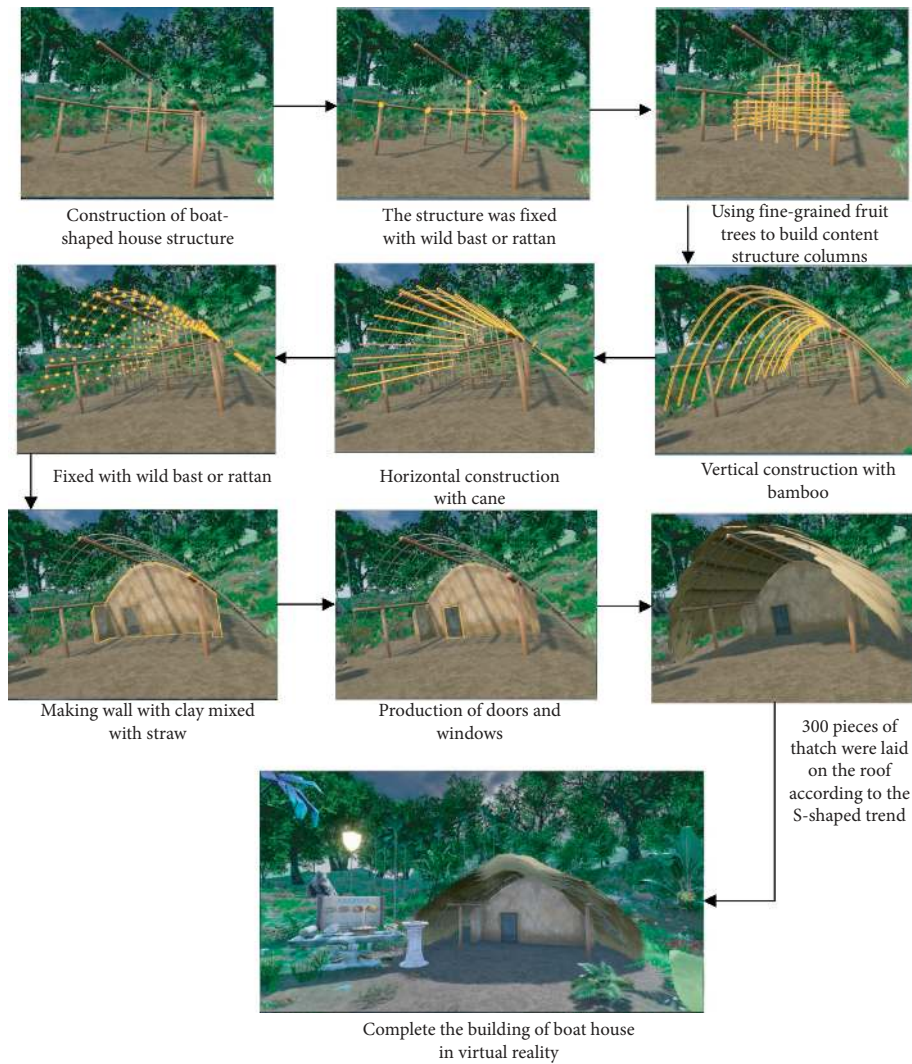
Construction of boat-shaped house structure

The structure was fixed with wild bast or rattan

Using fine-grained fruit trees to build content structure columns

Fixed with wild bast or rattan

Horizontal construction with cane

Vertical construction with bamboo

Making wall with clay mixed with straw

Production of doors and windows

300 pieces of thatch were laid on the roof according to the S-shaped trend

Complete the building of boat house in virtual reality

FIGURE 8: Construction process of the boat-shaped house in virtual reality platform.

FIGURE 9: Virtual Li Village display effect in UE4.

4. Virtual Reality Is an Effective Way to Spread the Boat-Shaped Houses of the Li Nationality

In 1965, Ivan Edward Sutherland (Ivan Edward Sutherland, May 16, 1938) proposed the basic scheme of virtual reality technology, known as the father of computer graphics. In the 1980s, digital technology was recognized and applied to business. In the 1990s, digital technology has begun to penetrate education, medical, industrial, and service industries. The emergence of networks has accelerated the development of digital technology. By the end of the 21st century, virtual reality technology has been developed rapidly and shipped to all walks of life. Due to the bottleneck of network speed and the relative lack of content, there is currently a downward trend, but after 5G will usher in a spring, because of 5G's it appears that although the virtual the network speed is no longer a concern but the VR production still will face the lack of content. How to use

virtual reality technology to bring more convenience to our life, culture, art, or entertainment will be what we need for further research and development.

The application of virtual reality technology and the protection of intangible cultural heritage can add many places that have been lost, weakened, and alienated in the virtual environment, as well as environmental factors that disappeared due to natural environment and social changes; it will also help record and restore the original appearance of the material cultural heritage. Virtual reality technology to protect intangible cultural heritage has the characteristics of strong spread and wide coverage. Digitalized intangible cultural heritage through virtual reality technology can be spread on the network at high speed and convenience. This way breaks the limitation of time and space. By making the content of intangible cultural heritage in a digital museum and searching through virtual reality devices, we can experience and share content through the network. In the era of 5G networks, there will be no more obstacles to the spread of virtual reality content.

Hainan has beautiful scenery and is very suitable for the development of tourism culture. During the development process, it is particularly important to display and promote the intangible cultural heritage. The tourism culture of Hainan is currently limited to the display of tourists. Tourists are mainly visiting, lacking initiative and interaction, and unable to understand the deep cultural connotation. The combination of virtual reality, historical and cultural resources, and the humanistic spirit allows tourists to actively explore and develop the mysteries of culture and inspire visitors with virtual scene construction, virtual interactive scene settings, virtual character interaction, and virtual historical events. Through the development of the abovementioned virtual reality on the building skills of the Li boat-shaped house, it can play three roles in the development of this intangible cultural heritage:

(1) Simulation of shipbuilding technology

Simulation refers to the technology of using the virtual model system to reproduce the real model system and study the actual model in existence or design through the experiment of the virtual model. Simulation maximizes the virtual Li Village tour system through VR technology. This article confirms the inevitability of the existence of Li Village from the construction skills and humanistic meaning of the boat-shaped house. The construction of the boat-shaped house is an indispensable traditional skill of Li Village. Through the field survey of the Li people, the location, material selection, and construction methods of the boat-shaped house are studied to improve the accuracy of the simulation design. Starting from meeting the requirements of digital protection and inheritance of boat-shaped house skills, this simulation successfully demonstrated the establishment of a three-dimensional boat-shaped house model. By establishing a three-dimensional virtual reality platform and various computer functions, the virtual interaction of boat-shaped house-building skills was realized. The role of the simulation of the boat-shaped house is to use VR technology to restore the real Li village and the boat-shaped house construction scene. Experiencers can actually see the excellent traditional skills of the Hainan Li people and the environment of the life of the Li people by wearing VR glasses or head-mounted displays.

(2) Broadening the transmission of traditional handicraft skills

The people of the Li ethnic group in Hainan are the key to the long-term life of the boat-shaped house-building skills and the guardian of the inheritance of traditional skills. The development of modern society has forced the people of the Li nationality to accept a more advanced life, but the ancestors of the Li nationality who mastered the technology wanted to pass on the craft of building a boat-shaped house to the new generation based on their respect for their ancestors. But in today's era of modernization development, fewer and fewer young people of the Li nationality are willing to learn the skills of building a boat-shaped house. In terms of inheriting handicraft skills, in order to avoid the demise of craftsmanship, the building techniques of boat-shaped houses have been included in the national traditional handcraft intangible cultural heritage.

The application and research of VR technology provide a new way for the protection and dissemination of the digitalization of shipbuilding technology. As mentioned above, one of the difficulties in inheriting intangible cultural heritage is the lack of inheritors. Through the digitalization of VR technology, the problem of inheritors can be solved in the following ways: (1) The intangible cultural heritage, as an excellent folk culture in Hainan, is combined with local teaching, combining traditional manual skills and VR technology, with the curiosity of VR technology. Cultivate students' sense of protection and inheritance responsibility for Hainan's traditional handicrafts. (2) The development of the museum has also begun to combine with digital technology. Under the background of "Internet +" and "big data," the museum fully utilizes the characteristics of high openness and interactivity of network transmission, and the establishment of a VR display area to provide simulated interaction has also attracted more young people concerned about cultural heritage. (3) With the popularization of mobile terminals in modern life, mobile phones have become an indispensable part of our lives, and the popularity of mobile media such as mobile phones provides a good communication channel for digital content. The digital traditional technology protection system based on VR technology is packaged and output as a mobile terminal. People can use the

remote sensing technology of the mobile terminal to experience the simulation system. They can also be equipped with higher Google VR glasses or other brands of VR sprites to obtain a far better experience; these methods are exactly what young people love and are receiving.

In summary, VR technology brings a greater width than traditional media for the inheritance and transmission of traditional manual skills. The general public can also actively participate in the inheritance and dissemination of traditional manual skills while enjoying the joy brought by VR technology.

(3) Optimize the effect of immersive interactive tour

Interaction defines the content and structure of communication between two or more interacting individuals and is divided into visual interaction and experience interaction. Traditional sensory experience interactions mostly appear in museums and game malls. Through some programs and interactive commands for audiovisual media, the experiencer can interact with the work through language commands and click on the display, and body language and other actions then feedback the results through the display. With the rapid development of technology, the emerging immersive interaction has also emerged where most of them are used in new media art exhibitions. Although participating in it will give people a sense of physical and mental pleasure, setting up the exhibition is time-consuming and laborious, and it will consume a lot of materials. The VR technology can make the digital tour system real-time interaction, thus forming a special art form that integrates experience, psychology, immersion, and virtual communication.

The boat-shaped house construction of the Li Village tour system is taken as an example in this study; VR technology is used to allow the experiencer to navigate into a virtual world parallel to real life through the head-mounted VR glasses anywhere. In order to allow the experiencer to feel both real and different from the real world, when constructing the virtual world of Li Village, many interactive places were set up. First of all, we can use the VR video to play an example of boat-shaped house construction. Experiencers can also experience the complete process of building a boat-shaped house by manipulating the VR handle to experience the charm of traditional craftsmanship. VR technology breaks the traditional way of experience interaction, allows the experiencer to integrate into it, and brings him an immersive experience, giving people a wonderful sense of space, accompanied by auditory elements such as music and environmental sound effects with Li nationality. The controller can directly interact with the virtual world around him.

5. Conclusion

Intangible cultural heritage has encountered difficulties due to social development and some of its own shortcomings. It is precisely because of the development of social technology that we have seen more possibilities. The popularity of the Internet and the maturity of multimedia technology have broadened the digital development direction of intangible cultural heritage. Thomas Peters (Thomas Peters is the most prestigious master of management in the United States. He co-authored "The Pursuit of Excellence" with Robert Waterman Jr. and later with Nancy Austin. "Aim to Success") said the distance has disappeared, either innovation or death. It means that the crisis or danger of life is approaching us step by step, and we have to wait to die if we do not reform or innovate. The innovation in the digital protection of cultural heritage seems urgent. Although this is his opinion on management, it is also the choice facing intangible cultural heritage. The innovation of intangible cultural heritage should be combined with the development direction of each region to make distinctive innovations. The development of intangible culture in Hainan should be combined with tourism culture. While attracting a large number of tourists to experience the natural scenery in Hainan, it is necessary to show the humanistic connotation of Hainan. Intangible culture can be combined with the development of online digital content and tourism to produce some digital products based on Hainan attractions. Through the Li boat model house project, the intangible cultural heritage of Dongfang City in Hainan Province which is boat-shaped has been inspected, researched, and summarized. According to the characteristics of the tourism of Dongfang City, virtual reality is produced. The nonlegacy game can not only save and spread the boat-shaped house but also promote the tourism of Dongfang City. Therefore, through the production of nonlegacy content using virtual reality technology, we can combine virtual reality game products with animation peripheral cultural and creative products in the future and promote them online and offline at the same time.

First is to introduce virtual reality content products into museums. Modern museums can not only be limited to traditional physical display methods. They can use digital technology to narrow the distance between the audience and the history of cultural relics. They can also use remote viewing methods to make virtual reality enhance the audience three-dimensional perception of historical relics and the world in history can "experience" all the historical events that have happened. It is also possible to set up a feedback mechanism for the audience and timely revise the defective places to give the audience a better perception experience.

Second, an intangible cultural heritage entertainment experience hall was established. The intangible cultural heritage has a sense of distance from the modern youth because of the historical information it carries. Through the development of virtual reality games and animation products, the distance between history and reality is eliminated. Let the intangible cultural heritage come out of the museum, and set up an entertainment experience hall featuring the intangible cultural heritage, which will be used to experience games and display and sell related animation, cultural, and creative products. This entertainment experience hall can be combined with tourist attractions and targeted to set up

entertainment experience halls at various tourist attractions to enhance the fun of tourism.

Third is to establish an online virtual reality showroom, through the promotion of pages and online stores, through the current mobile media, online platforms, WeChat, Facebook, Kakao, YouTube, etc., online display, and promotion.

Through the concrete examples of the construction of the deep learning CNN-based virtual reality platform of the Li boat-shaped house in the above paper and the constructive analysis of market promotion, this analysis has laid the foundation for further research on how to conserve and integrate intangible cultural heritage with digital technology through our VR platform. The above analysis is a proposal for how to strengthen the barrier-free communication between intangible culture and people, which also gives us a deeper consideration of why the content generated by human spiritual civilization will gradually disappear and a deeper consideration of how to strengthen civilization communicated with the modern to reduce barriers.

Data Availability

No data were used to support this study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

Acknowledgments

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