

Retraction

Retracted: Relevance of Ancient Chinese Wine Ware Representation Design and Cultural Characteristics Based on Machine Learning and Semiotic Theory

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1].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

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

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

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

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

The corresponding author, as the representative of all authors, has been given the opportunity to register their

agreement or disagreement to this retraction. We have kept a record of any response received.

References

- [1] W. Wang, J. Wei, H. Xu, Y. Zhang, and H. Chen, "Relevance of Ancient Chinese Wine Ware Representation Design and Cultural Characteristics Based on Machine Learning and Semiotic Theory," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 2035662, 14 pages, 2022.

Research Article

Relevance of Ancient Chinese Wine Ware Representation Design and Cultural Characteristics Based on Machine Learning and Semiotic Theory

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Wine has an indispensable position in the ancient national food culture. Among them, wine vessels, as material carriers, are the core of ancient national wine culture, reflecting social functions, plastic arts, craft production, customs, habits, etc., and therefore are also the concrete expression of spiritual and institutional culture. Ancient ethnic traditional drinking vessels are not only a comprehensive manifestation of the precious material cultural heritage but also of the ancient spiritual culture of the nation. Through the study of the representational design and cultural characteristics of ancient ethnic traditional drinking vessels and the aesthetic tendencies they reflect, we can see the unique philosophy of life and the spiritual reverence of ancient peoples. Although these traditional ancient ethnic drinking vessels are now gradually marginalized and some have completely withdrawn from the historical stage, their spiritual and cultural value has increased rather than decreased. This paper explores the representational design and cultural characteristics of ancient traditional drinking vessels and the aesthetic tendencies they reflect and analyzes the correlation between them using ML methods and semiotic theory, to get a glimpse of the unique talent and wisdom of the ancients in aesthetic creation and gain new design inspiration from them.

1. Introduction

“People’s food is the sky,” and food is an important component of material culture. Compared with the connotation of other material culture, the importance people attach to food is incomparable to any other material culture, and its status is unshakable [1]. Whether it is anthropology, ethnology, history, archaeology, or sociology, food culture is important in the study of material culture. Food culture has the nature and characteristics of symbols, and its functions include the triple attributes of food to people’s physiological needs, psychological needs, and social needs, with food as a symbol to convey information to reflect the cultural phenomenon of human beings [2].

China is a vast country with many ethnic groups. Not only has the brewing industry been in existence in the Central Plains since remote antiquity but also in the south, southwest, northwest, north, and northeast of the country,

with some having more regional and ethnic characteristics. The Inner Mongolia grassland region in the north, in particular, is blessed with natural geographical conditions conducive to the sustainable development of animal husbandry and agriculture and is therefore one of the birthplaces of Chinese wine culture [3].

Wine, a special beverage, occupied a significant position and a large proportion in the life of ancient peoples. As a result, ancient peoples inevitably seized wine into art when describing their lives and could not help but use drinking as a means of expressing their aesthetic feelings, making wine have the function of artistic expression [4].

If there is wine, there must be wine ware, wine ware with the invention of wine and the development of social productivity and development. As an important carrier of wine culture, the study of ancient national wine vessels can provide a deeper understanding of the traditional culture of ancient peoples and the long history of our nation. As the

saying goes, “although the vessel is small, the ritual is really big.” Nowadays, the grassland culture, which integrates the national style and the atmosphere of the times, has a more vigorous vitality, and more and more Chinese and foreign scholars have begun to devote themselves to the study of grassland culture. However, most of the research results are focused on archaeology, but there are few studies on ancient ethnic wine culture and on the decorative art features of ancient ethnic traditional wine vessels and ethnic aesthetic psychology [5]. As a handicraft, wine tools are an important part of the eating utensils. In turn, wine was sacred and honored, and wine was not an entertaining drink in the beginning. Rather, it was more often used for rituals and to ward off evil spirits. Wine and drinking became part of the rituals of sacrifice and had a high social status. Although these traditional ancient ethnic drinking vessels are now gradually marginalized and some have completely withdrawn from the historical stage, their spiritual and cultural value has increased rather than decreased [6].

The drinking culture of ancient ethnic groups has a very close and intrinsic connection with their art. By examining the relationship between drinking customs and art, we can experience the hot and frank aesthetic emotions of ethnic minorities, the aesthetic theory of pursuing a happy life of freedom and equality and sincere and loving social relations, and the aesthetic form of expressing the straightforwardness and simplicity of the heart [7].

The ancient people regarded the silver bowl as a treasure, using it to hold rice, tea, and drinking wine. Due to the characteristics of life, this phenomenon of multiuse of one vessel was very common in the steppe. Modern ancient national silver bowl began to use the volume to distinguish the function of the silver bowl, drinking tea silver bowl volume becomes smaller, the volume of the silver bowl for toasting began to become larger, exaggerated, and gradually become a ceremonial supplies, such as Figure 1, only to enhance the ornamental and not the traditional ancient national silver bowl, but the real traditional ancient national silver bowl is its fixed scale, the height of about 5 cm, the caliber of about 12 cm [8]. This scale is designed to be suitable for their use.

China’s wine culture began almost along with the splendid civilization of 5,000 years, and since ancient times, there has been a tradition of treating guests with wine, expressing emotions with wine, and even curing diseases with wine [9]. As the bearer of wine culture, wine vessels have also evolved and passed on along with the prosperity of wine culture, becoming a pivotal item among the ancient living artifacts. The cultural traditions and ideas of creation carried in traditional Chinese wine vessels contain many excellent design ideas and design concepts [10]. These valuable material and cultural treasures are also the accumulation of the excellent cultural traditions of the Chinese nation and are the product of the combined effects of many factors such as politics, economics, culture and technology, and lifestyles of each period [11].

A symbol is a spiritual mapping and a carrier of material existence. Only the existence of spiritual meaning can transmit and circulate information in time and space. According



FIGURE 1: Silver wood bowl.

to Saussure’s semiotics, design semiotics is divided into two functions: “referential” and “referential” [12]. The “referent” refers to the deeper meaning of a specific thing or an abstract linguistic concept. For example, in daily life, when a rose is mentioned, the first reaction is to associate it with love, so the rose is the “energy reference” and love is the “reference.” Product design symbols are expressed in a product design through the combination of the external and internal functions of the product [13]. In other words, a product design symbol is a new symbolic image created and constructed by fusing design and semiotics to design a product that can have both practical and additional functions, thus enhancing the overall value of the product. Therefore, the study of ancient Chinese wine product design based on semiotics is to analyze the perceptual elements from a rational perspective and to recreate a combination of symbols to derive a relevant product that is more acceptable and interesting to users [14].

2. Related Work

Drinking alcohol is a cultural phenomenon shared by people around the world, and alcohol exists in any part of the world. It is just that different places have different kinds of wine. Due to the different natural environment of existence, China is mainly agricultural, and its wine culture is naturally represented by grain wine, i.e., Baijiu. Most Western countries, on the other hand, do not have a surplus of grain to make wine because their soil and climate are not suitable for the growth of many crops, and the yield of cereal crops is low. However, it has created favorable conditions for drought-tolerant grapes, and thus, the production and quality of grapes in Western countries are second to none. As a result, wine making has become a representative of the wine culture in the West. The different wines then produce their corresponding drinking utensils. Thus, different wine cultures permeate, giving it a very different style and colorful national characteristics. Due to the differences between Chinese and Western wine cultures, people’s drinking purposes, drinking behaviors, and drinking tributes are different, and the resulting drinking utensils are bound to be different [15].

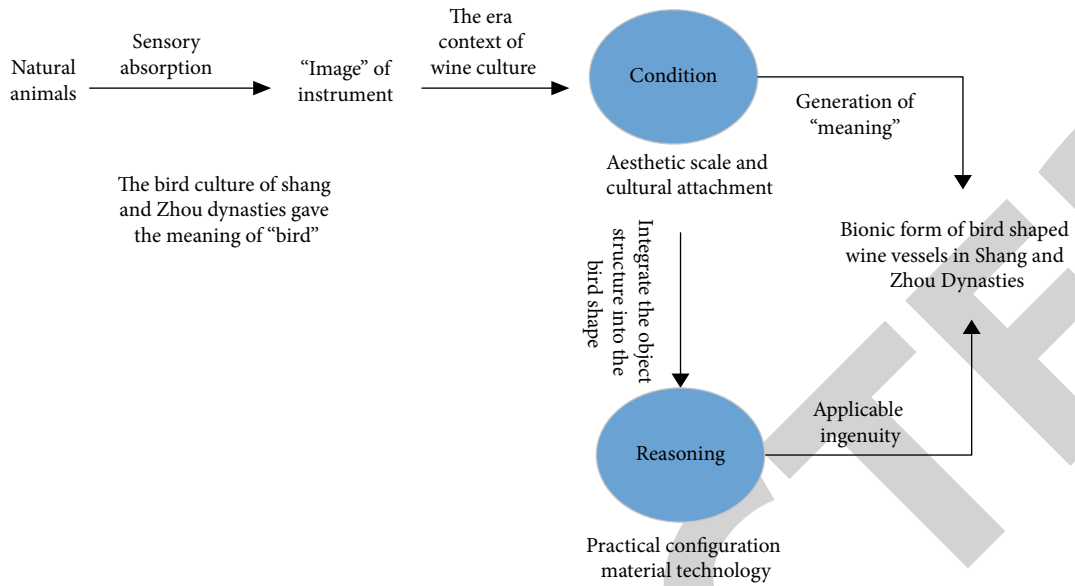


FIGURE 2: Design path of bird-shaped wine vessels in harmony with reason and emotion.

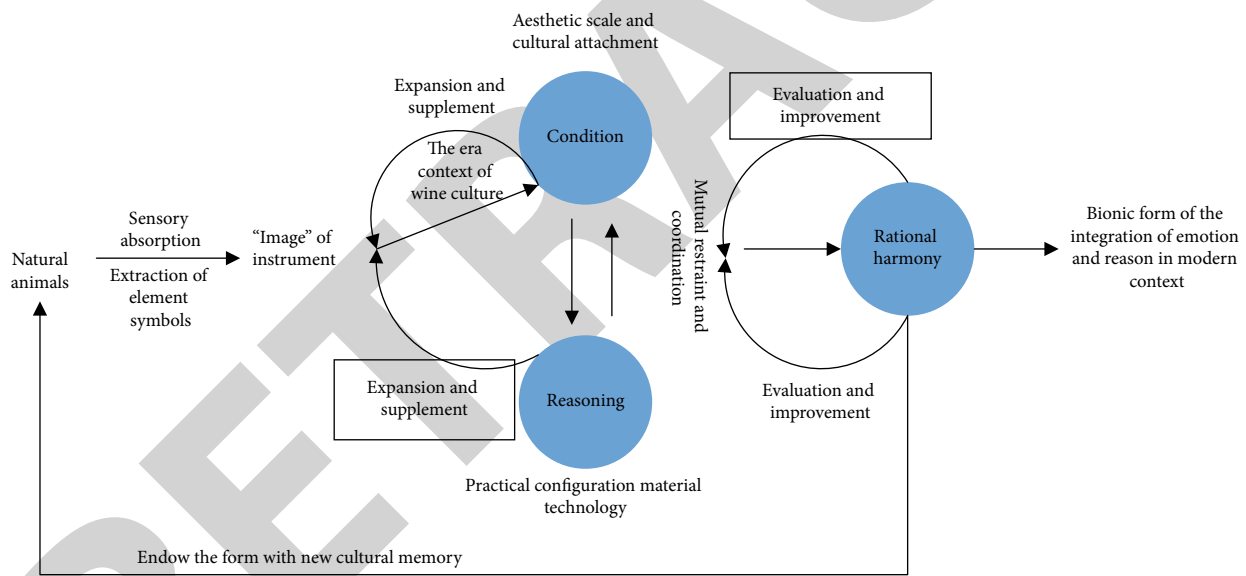


FIGURE 3: Design path of modern animal-shaped bionic wine vessel.

China is one of the first countries in the world to make wine, and wine and wine culture have always played an important role. In ancient times in China, it was often the case that “rituals were made with wine,” i.e., rituals could not be performed without wine. There is no wine to make rituals, where national celebrations, ancestor worship, wedding, funeral and marriage, childbirth, ushering and sending, almost all have to drink. Wine occupies an important position in the history of ancient Chinese culture, and wine culture has also penetrated into all aspects and levels of ancient social life, no matter politics, economy, culture, art, military, religion, etc., all associated with wine [16]. The development of modern society is also the same, wine is still used in various occasions to make friends and do things. In

ancient China, the drinking vessel produced by the liquor culture was the wine bowl, but since the emergence of distilled spirits, the volume of the drinking vessel became smaller as the wine became higher and eventually formed the current wine cup [17]. Therefore, liquor culture is dominated by drinking vessels made of ceramic, glass, plastic, and metal.

Westerners, on the other hand, drink wine for a different purpose from China, and they tend to drink for the sake of wine, to taste and appreciate it. Compared with Chinese liquor culture, its wine culture produces drinking vessels with goblets as the mainstream, whose materials are mainly glass and crystal, and they have a wide variety of wine vessel shapes, and each wine has its corresponding cup, because

TABLE 1: Artistic features of bronze wine vessels.

Bronze wine vessel (example)	Variations of wine vessels	Artistic features
Divorce with animal head	The bronze wine vessels of the Chu region were designed with a novel style of wine vessels	This is a new type of Chu bronze wine vessel, with partial design in the shape of animal heads and dragons, and the surface of the vessel is decorated with coiled-venom motifs.
Dragon ear and tiger foot square pot	Chu-style crossed and convex bands were used on southern bronze pots until the Warring States period and became a unique decorative pattern in southern Chu.	The slender shape of the square jug is decorated with a fine coiled-venom motif, and the simple decoration of a convex cross on the belly of the jug forms a contrast between the upper and lower parts of the jug, making the overall style more lively.
Bronze ice jin	The climate of the Chu region influenced the drinking style of the Chu people, for example, the words “freezing drinks” and “cold drinks” in the “Chu rhetoric” both mean cold drinks. Therefore, the freezing design of Chu wine vessels reflects the Chu people’s ingenious design needs and aesthetic awareness.	The design is a combination of a wine vessel “Zun Fou” and a wine vessel “Jian.” The design of the bottle is in the shape of dragon’s head and dragon’s ear, and the decoration is in the form of coiled chi dragons and banana leaves.

Westerners believe that different shapes of wine vessels have a crucial influence on the taste and temperature of wine [18]. Different wines use different drinking utensils and consequently produce different wine cultures, but it all exists in the mainstream of development. This paper analyzes the representatives of ancient ethnic wine cultures and the mainstream of drinking utensil development through the interpretation of different wine cultures. The ancient peoples, as inheritors of the grassland culture, were dominated by animal husbandry on the grasslands, which provided superior material conditions for the development of the wine-making industry because of the unique natural geographical conditions [19]. The people invented milk wine through their own wisdom. The basic method of making milk wine is to pour milk into a container, stirring and bumping, so that the cream separates and ferments to produce wine, which is a relatively simple that on brewing method, and the ancients have preserved it to today. The earliest archaeological and historical documents record that milk wine was skillfully produced by the Eastern Hu and Xiongnu, and therefore, milk wine is a representative of the ancient national wine culture. The variety of ancient ethnic drinking vessels that arose with it was diverse, and there existed the bush-ear cup, silver bowl, wine cup, wine jug, leather bag, flat jug, and so on. However, with the evolution and development of the times, the most complete and widely used is still the silver bowl. The ancient nationality formed the main drinking utensils with silver bowls, which showed different characteristics from Han Chinese and Western drinking utensils in terms of material, volume, style, and usage [20].

3. Analysis of the Characteristics of Ancient Chinese Wine Vessels

3.1. Characteristic Design. Chinese wine ware is symbolic because it has the characteristics of a symbol. First, it is a material existence that can be perceived, which can convey



FIGURE 4: Dragon head vessel.

information, and it is also a structural system composed of basic elements that can be combined according to certain norms, while the meaning of these elements has social conventions. The core of the ancient wisdom of simple creation, as the crystallization of traditional Chinese culture, is summarized as the design idea of “making the vessel and the image.” Ancient bionic creations were born from the creator’s observation and study of the “images” of plants and animals in the natural environment where people live. The analysis of the duality of emotion and reason in the Shang and Zhou bird-shaped wine vessels shows that the process of their creation was developed along the path from emotion to reason, and the design path of the integration of emotion and reason in the Shang and Zhou bird-shaped wine vessels is shown in Figure 2.



FIGURE 5: A square pot with dragon ears and tiger foot.



FIGURE 6: Copper sheet.



FIGURE 7: Bronze ice goblet.

Based on the design path of the bird-shaped bionic wine vessel and combined with the above design transformation elements of modern wine vessel design, the design path of

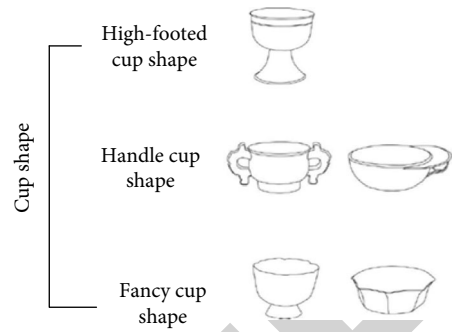


FIGURE 8: Cup shape correlation map.







TABLE 2: Cup shape control table.

The shape of the cup handle	Illustration
Double dragon ears	
Petal-type griddle ear	
Openwork-type ao ear (burin engraved scrolling grass pattern)	
Flat-shaped jin	

modern animal-shaped bionic wine vessels is summarized in Figure 3.

In this paper, we apply the basic principles of semiotics to the study of Chinese wine vessels, especially ancient ones, and interpret the symbolic design of wine vessel representations from three levels: semantics, semantics, and semantics, in an attempt to draw inspiration for modern wine vessel design and to benefit from the inheritance of China's wine culture for thousands of years and the development of modern wine vessel design. Modern wine ware design should not only inherit the excellent qualities and symbols of traditional wine ware culture but also innovate in the context of modern design, using semiotic theory to construct new symbols to

TABLE 3: Wine local decorative pattern (natural plant pattern).

Ornamentation	Ornamental features	Typical wine vessel	Illustration
Floral pattern	Also known as “Manju vine,” it is a traditional decorative pattern. It is made of a kind of vine that changes into branches and stems that are twisted in a continuous wave shape, and the branches and stems are filled with flowers and leaves to form a twisted branch pattern.	Engraved gold cup with high foot (mouth rim)	
Curly grass pattern	It is also known as the “vine pattern.” On a continuous “S”-shaped curve, it is decorated with various branches, leaves, flowers, or other decorative patterns, forming a unique pattern that expresses the life form of plants. It has a sense of movement and rhythm, symbolizing the tenacious vitality of everything in the universe.	Gold cup with lion ears (mouth rim)	
Lonicera pattern	Commonly known as “honeysuckle,” it is usually a pattern with three petals and one petal born on both sides of an undulating stem and is mostly used as a Buddhist decoration, probably with the auspicious meaning of “longevity.”	Gold cup with petal-shaped griddle ears (mouth rim)	
Chrysanthemum pattern	The chrysanthemum pattern is a kind of flower pattern, with long and thin petals and a large number of petals. The chrysanthemum pattern has the meaning of blessing longevity and metaphorical gentleman.	Gold cup with chiseled ears (inner base)	
Lotus pattern	The most used lotus pattern in wine ware is the “overlying lotus pattern” and the “back overlying lotus pattern.” The overlapping lotus pattern has the petals hanging down, like a lotus flower upside down. The upward and overlapping lotus pattern is a combination of the upward and overlapping lotus patterns with the petals upward.	(1) White copper and gilt-silver dragon head jug (covered with lotus pattern) (2) White copper and gilt-bronze dragon head jug (with lotus pattern on the back)	 

create wine ware works with Chinese characteristics that are loved by people.


The wine vessels were beautifully designed, with smooth and flowing lines of ornamentation, varied, complex and elegant, and majestic and exuberant beauty. The development of bronze wine vessels in the south was deeply influenced by the culture of the Central Plains, but with the gradual disintegration of the Zhou rituals and the strength of culture and art, new changes were introduced, and the wine vessels began to have strong local characteristics. As shown in Table 1 that new varieties of bronze wine vessels emerged, including those with traditional shapes, such as the animal-headed divorce and the Chu-style square jug with crossed convex bands. The decoration of wine vessels is also full of abstract artistic expression of realistic scenes in the spirit of Chu romanticism. They are also abstract artistic expressions of realistic scenery in the spirit of Chu romanticism, such as various coiled vipers and banana leaves. The climate of the Chu people influenced the way they drank, such as the

words “freezing drink” and “cool some” in the “Chu rhetoric,” both meaning cold drink. This paper will analyze the artistic characteristics of bronze drinking vessels from the excavated examples of bronze drinking vessels, as shown in Figures 4–7.

The shape of cups among the drinking vessels used by ancient peoples varies, mainly high-footed cup shape, fancy cup shape, and handle cup shape; see Figure 8 for the correlation of cup shape and Table 2 for the shape of cup handle.

3.2. Decorative Pattern Characteristics. With the continuous development of the ancient national daily crafts, people call the pattern design on all the artifacts above the pattern. Decorative patterns and ancient life are closely related, and it can be said that life is the root of ancient national folk patterns, and folk patterns are also a mirror of life. Most of the decorative patterns used in the ancient national drinkware are also derived from the ancient national folk patterns. Ancient peoples were both simple, brave peoples and

TABLE 4: Wine local decorative pattern (animal pattern).




Ornamentation	Ornamental features	Typical wine vessel	Illustration
Dragon pattern	The dragon is an ancient symbol of the gods and strength of the dragon pattern in the Yuan dynasty; there are fluttering hair; the legs have “exposed tendons and bones” pattern. In the Ming dynasty, the tendons and bones evolved into the legs all pulling the line, the head hair upward, the dragon beard outward or inward scrolling, and the emergence of windmill-like five claws. In the Qing dynasty, the dragon’s head was hairy, with jagged gills, and the tail was decorated in the shape of autumn leaves.	Silver wine jug with dragon pattern (abdomen)	
Lion ball pattern	After the Song dynasty prevailed lion play ball pattern, called “lion ball pattern.” Yuan, Ming, and Qing dynasties, there are double lions, three lions, etc.	A white bronze double lion and treasure-bearing dragon head jug (abdomen)	
Beast pattern	Beast pattern is the shape of the beast, according to the pattern made ornaments. The image of the beast is not specific, generally have oval eyes, the upper lip is also long and thick, with feet and tail, shaped like a fierce beast may be a dragon or tiger pattern of the deformation.	Silver wine jug with a spitting beast motif (abdomen)	
Deer pattern	Deer pattern is a realistic animal pattern, deer have two large horns, beautiful body shape, often used as a pattern. It is often used as an ornament. It is also known as “Roku.” It has an auspicious meaning.	Silver wine jug with deer motif (abdomen)	
Horse pattern	The Mongolian people are known as the “horseback people.” The horse motif was used on the imperial ceremonial banner in the Yuan dynasty public service system. It is surrounded by flames or engraved flying clouds.	Engraved silver covered wooden bowl (bottom)	
Frog pattern	The frog pattern is one of the aquatic animals. There are concrete and abstract forms. The frog symbolizes many children and foretells a good harvest of rice.	Bronze wine jug (belly)	

beauty-loving peoples. Decorative patterns and people’s lives are closely related, ancient national life in the clothing, food, housing, transportation are more or less related to the pattern. The decorative patterns of ancient national objects are even more colorful.

The decorative patterns of ancient national wine vessels can be broadly divided into four types according to different expressions.

3.2.1. *Botanical Motifs.* As shown in Table 3, the common botanical patterns of ancient ethnic decorations include shandan, apricot, plum, peony curl, folding flower, leaf, petal, peony, grass, plum, pomegranate, chrysanthemum, apricot, doughnut, orchid, lotus, lingzhi, bamboo, and persimmon. The patterns on the rim of the goblet and the foot of the jug are all botanical patterns, and the ones that appear more frequently are the entwined floral pattern, the scrolling

TABLE 5: Wine local decorative pattern (auspicious patterns).

Ornamentation	Ornamental features	Typical wine vessel	Illustration
Eight Treasures pattern	The Eight Treasures is one of the auspicious and symbolic motifs. It is a pattern composed of eight Buddhist Dharma vessels. It includes the treasure umbrella, double fish, treasure vase, flower, conch, auspicious knot, honorable victory block, and Dharma wheel.	(1) Purple bronze and gilt silver dragon's head jug (foot)	
		(2) Silver covered wooden bowl (inner foot)	
Longevity pattern	The reunion longevity pattern is a single character pattern. It is mostly used on the abdomen of the vessel, and the character Shou is round.	Silver and gilt silver dragon's head ewer (abdomen)	

grass pattern, the lonicera pattern, the entwined chrysanthemum pattern, the lotus pattern, and so on.

3.2.2. *Animal Motifs.* Ancient national patterns are influenced by the psychological substrate of the nation. Pattern art, like folk songs, glorified Mongolian heroic tasks in a unique form. Patterns such as lions and eagles are symbols of heroic figures. On the daily utensils, the lion and dragon patterns were liked to be used as decoration. See Table 4.

3.2.3. *Auspicious Motifs.* Ancient ethnic pattern patterns were also influenced by the pattern art of other ethnic groups, seen in ancient ethnic patterns of joy, longevity, plum, bats and some auspicious patterns to dragon and phoenix, peony, lotus, and other patterns. See Table 5.

3.2.4. *Geometric Patterns.* This kind of pattern is the result of patterning, geometry, simplification, and pattern of natural patterns, auspicious patterns, and other patterns. See Table 6.




3.3. *Semiotic-Based Interpretation of the Characteristics of Ancient Wine Vessels.* Interpreting ancient Chinese wine vessels from a semiotic perspective, the basic elements that make up ancient Chinese wine vessels in terms of pattern, color, composition, and the comprehensive display of meaning not only provide beautiful ornamental qualities for local people's home beautification but also meet spiritual and cultural needs such as cultural inheritance and praying for well-being, both of which together form the semiotic characteristics of ancient Chinese wine vessels, as shown in Figure 9.

The symbols used in the works are conventions from the people's life experience, and the graphic symbols show the beautiful aspirations of the local people and then use them to express different symbolic meanings.

3.3.1. *The Morphological and Symbolic Characteristics of Ancient Chinese Drinking Vessels.* The representational characteristics of ancient Chinese drinking vessels are that the "referential" object is a true depiction of the life of the local people, and the implicit characteristics are that the "referential" object is the people's desire for a better life expressed through the representational design of ancient Chinese drinking vessels. By analyzing the works of ancient Chinese wine vessels, the graphic patterns can be divided into, firstly, nature-themed patterns: sun patterns, water wave patterns, and crescent patterns. The second is animal motifs: bat motifs, toad motifs, bee and butterfly motifs, and fish motifs. The third is the pattern of plant theme: petal pattern, chrysanthemum pattern, lotus pattern, curly grass pattern, etc. The fourth is the pattern derived from the worship of religious beliefs: Fang Sheng Ru Yi pattern, etc. The fifth is the abstract pattern in daily life: polka dot pattern, money string pattern, door curtain pattern, etc. These motif symbols are closely related to the life of local people and are particularly evident in the works of Ku Shulan, a nongeneticist, who has lived and experienced her personal life. Her ancient Chinese wine ware representations are rich in subject matter and are divided into six major themes: first, love life, second, auspicious scrolls, third, cut flower maidens, fourth, fairy tale world, fifth, rural folklore, and sixth, religious worship.

3.3.2. *Color Symbolic Characteristics of Ancient Chinese Wine Vessels.* The color of ancient Chinese wine vessels is gorgeous but not gaudy, and they are well liked by people, and the design of ancient Chinese wine vessels is well sold overseas. The color scheme of ancient Chinese wine vessels mostly adopts the "five elements," complementary colors and gradient colors. Ancient Chinese wine ware designs often use a divided composition, with the money string

TABLE 6: Wine local decorative pattern (geometric patterns).

Ornamentation	Ornamental features	Typical wine vessel	Illustration
String pattern	A type of geometric stripe. The simplest type of line stripes.	A high-footed cup with a cloud and dragon motif in blue and white (mouth rim)	
Curly cloud pattern	The basic image is a kind of geometric pattern with long, thin lines. The basic lines are “∫” and “6,” and the contrast between thickness, density, black and white, and reality is used to form various round and round patterns.	Gilt silver cup with octagonal shape (mouth rim)	
Return pattern	A type of cloud and thunder pattern. The basic image is that the lines are curled in a square shape, resembling the word “back.” It is generally arranged in a continuous square pattern. It mainly plays the role of border decoration.	Purple bronze and silver gilt dragon’s head jug (lid)	

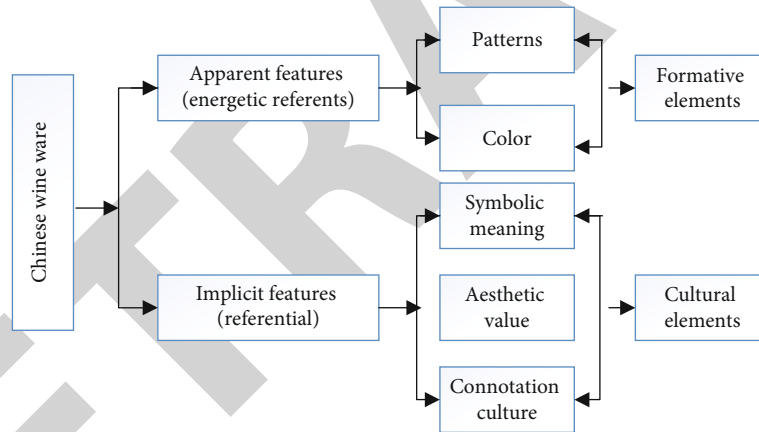


FIGURE 9: Semantic interpretation model of ancient Chinese wine vessel symbols.

pattern, flower petal pattern, and curtain pattern often used as symbols for the division, and the color is mostly cyan. The color red has always given people a visual impression of redness, joy, and peace and is favored in traditional ancient Chinese wine ware designs, and it is no exception in ancient Chinese wine ware

According to the characteristics of the wine ware characterization design data, the characterization data are first preprocessed (normalized) to eliminate the influence of the magnitude, and then, the characterization data are filtered by the single class support vector machine (OCSVM) algorithm, and the characterization data are classified and identified by the characterization data correlation model obtained by deep neural network learning, and the classified wine ware characterization design activities are mapped with the preestablished association. The classified design activities are mapped to the preestablished association rule base, and

the cultural features are inferred using a decision tree algorithm to obtain the results of the association between the design and cultural features. The processing flow of the association method between the design of wine ware representations and cultural features is shown in Figure 10.

In order to eliminate the influence of the amplitude distribution and magnitude caused by perturbations and to improve the speed and computational accuracy when detecting and processing gradient descent for optimal solutions, it is necessary to normalize the characterization data. In this paper, the level values of the characterization data are normalized using the maximum and minimum values in the range of [0, 1], and the normalization processing equation.

$$x_i^* = \frac{x_i - x_{\min}}{x_{\max} - x_{\min}}. \tag{1}$$

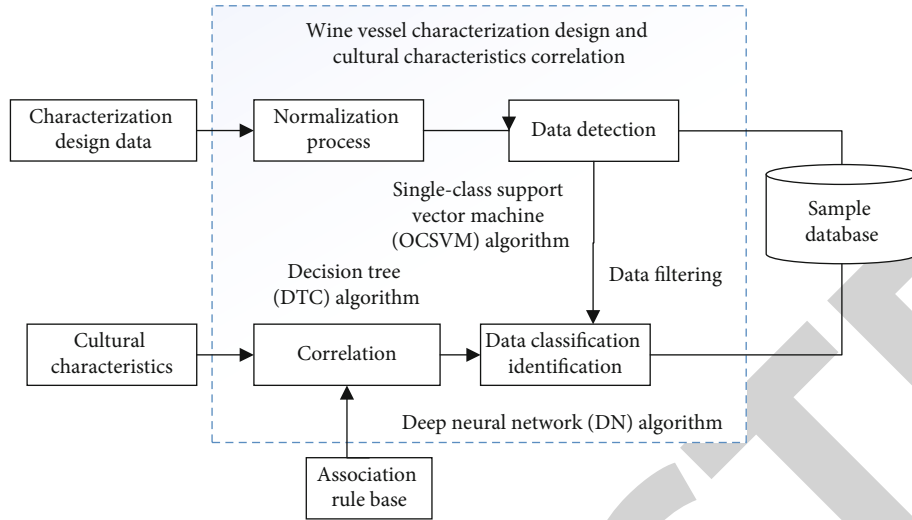


FIGURE 10: Chart of wine vessel characterization design and cultural characteristic correlation processing.

TABLE 7: Judgment results of characterization data.

Signal marker	Degree of correlation	Whether correlated	Real situation	Correctness
D0	0.11	No	No	Correct
D1	0.43	No	No	Correct
D2	0.22	No	No	Correct
D3	0.45	No	No	Correct
D4	0.28	No	No	Correct
D5	0.17	No	No	Correct
D6	0.43	No	No	Correct
D7	1.00	Yes	Yes	Correct
D8	1.00	Yes	Yes	Correct

TABLE 8: Characterization design data correlation judgment results.

Signal marker	Degree of correlation	Whether correlation	Real situation	Correctness
D0	0.11	No	No	Correct
D1	0.43	No	No	Correct
D2	0.22	No	No	Correct
D5	0.17	No	No	Correct
D6	0.43	No	No	Correct
D7	1.00	Yes	Yes	Correct
D8	1.00	Yes	Yes	Correct

The representation data are complex and diverse, and a detection algorithm is needed to filter the wine ware representation design data outside the space of all wine ware representation designs contained in the mapping rule set. OCSVM is a novel detection method that is well suited for training sets of uncontaminated, high-dimensional, nonlinearly distributed data, and the model can be trained based on normal samples only, avoiding the high cost of sample collection and having advantages that traditional correlation methods do not have.

First, the training set data is fed into the OCSVM algorithm to obtain the detection model, and then, the test set data is fed into the model to obtain the final prediction results. Since multiple samples are taken for each type of drinker characterization design data in the test sample, we count the proportion of samples with a prediction value of -1 for each characterization data, which is expressed as the rate. A judgment threshold of 8 is set, and those less than this threshold are normal classes or classes already in the training set, and those greater than or equal to this threshold

TABLE 9: Cultural characteristic data correlation judgment results.

Signal marker	Degree of correlation	Whether correlation	Real situation	Correctness
D1	0.43	No	No	Correct
D2	0.22	No	No	Correct
D3	0.45	No	No	Correct
D4	0.28	No	No	Correct
D6	0.43	No	No	Correct
D7	1.00	Yes	Yes	Correct
D8	1.00	Yes	Yes	Correct

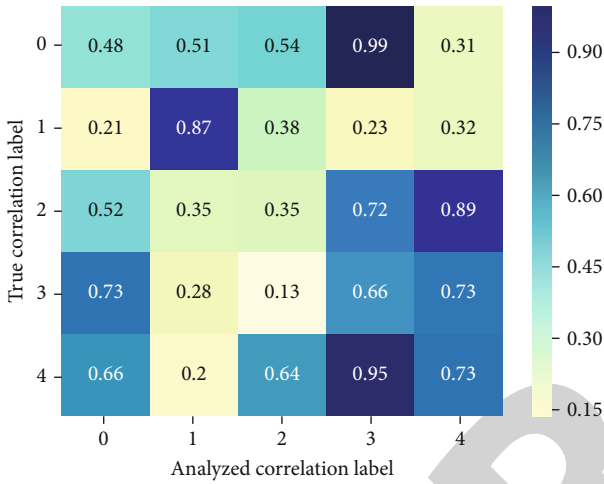


FIGURE 11: Correlation results of sample 1.

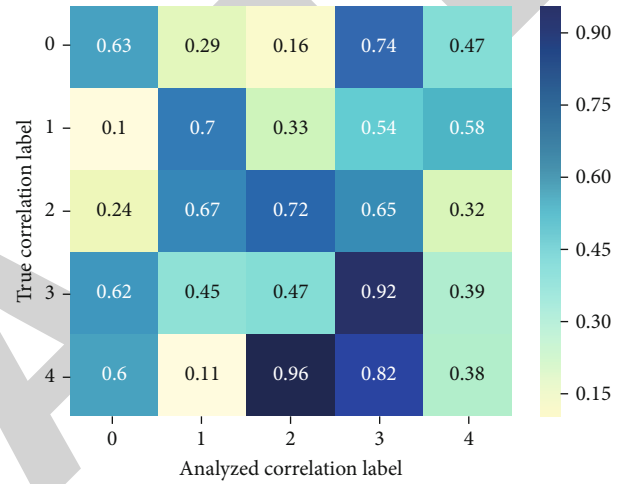


FIGURE 12: Correlation results of sample 2.

are classes or classes not in the training set, and all samples belonging to this class are filtered out.

The filtered design data of wine ware representations using OCSVM algorithm needs to further complete the correlation recognition of wine ware representation design data types in the association rule base. The deep neural network (DNN) method is an excellent correlation recognition algorithm that can approximate any function with arbitrary accuracy, and the correlation itself is the process of determining the correlation discriminant function. In addition, the algorithm itself has a strong learning capability and can adapt to changes in the data space better than the traditional statistical-based correlation algorithm. In this paper, the DNN method is used to learn the representation data for correlation and recognition of wine ware design.

Firstly, we build the neural network model. We use TensorFlow to complete the DNN network construction, set the decay rate of each layer, the number of batch training samples, the number of loop iterations, learning rate, etc., and select the excitation function. Next, the neural network correlation model training is performed. Finally, the correlation prediction labels of all the characterization data test samples are obtained, and the confusion matrix to evaluate the accuracy of the prediction results is calculated by comparing the predicted labels with their true labels.

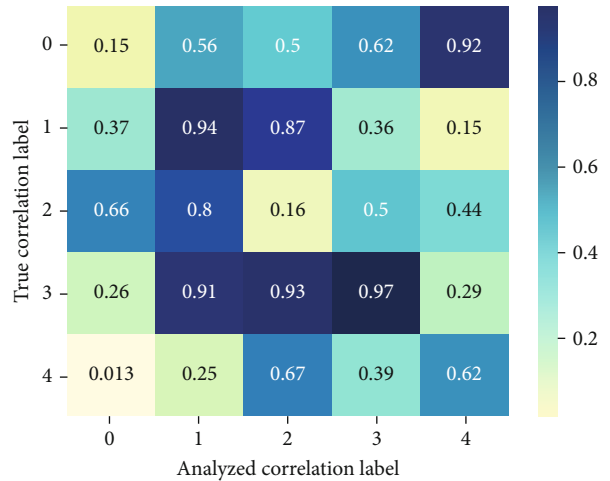


FIGURE 13: Correlation results of test sample 3 data.

Before the association of wine ware characterization design with cultural features, firstly, based on the characterization data detection and correlation identification methods in the previous two sections, the characterization data are subjected to nonrelevant data rejection and wine ware characterization design correlation identification, and then, the obtained wine ware characterization design identification

TABLE 10: Results of the association between the wine vessel representation design and cultural characteristic.

Samples	Predicted wine vessel representation value	Predicted cultural characteristic properties	True cultural characteristic attributes	Association correctness
Test sample 1	3	E3	E3	Correct
Test sample 2	1	E1	E1	Correct
Test sample 3	2	E2	E2	Correct

results are associated with the association rule base using ML methods, and finally, the cultural feature results are inferred.

Firstly, the data of the association rule base between wine vessel representation designs and cultural features are constructed as training samples, i.e., the combination of different wine vessel representation designs known in advance and the association relationship occurring with the corresponding cultural features are numerically characterized to form a series of samples. Specifically, a vector of equal length to the number of wine vessel characterization designs is formed with each wine vessel characterization design status (1 for occurrence and 0 for nonoccurrence), and the corresponding occurring cultural features are labeled with numbers (the same cultural feature is labeled with the same number) as category labels. Next, the training samples and label vectors are fed into the decision tree model to train the model. Finally, the result of correlation and recognition of the representation data is processed to obtain each wine vessel representation design state (vector containing 0 or 1) as test data.

4. Case Study

The simulation validation used characterization data collected from a test site as the test sample. Nine types of characterization data with different central frequencies were used, and D0 to D8 were used to represent these nine types of characterization designs, where D0 to D6 represented the characterization designs associated with cultural features and D7 and D8 were characterization designs of wine vessels.

To verify the algorithm, four cultural features “E1,” “E2,” “E3,” and “unknown event,” the set of all wine vessel representation designs associated with the four events is {D0, D1, D2, D3, D4, D5, D6}.

$D0 \text{ occurrence} \wedge D1 \text{ occurrence} \wedge D2 \text{ occurrence} \wedge D5 \text{ occurrence} \leftrightarrow E1.$

$D2 \text{ occurrence} \wedge D3 \text{ occurrence} \wedge D4 \text{ occurrence} \wedge D6 \text{ occurrence} \leftrightarrow E2.$

$D0 \text{ occurrence} \wedge D1 \text{ occurrence} \wedge D2 \text{ occurrence} \wedge D4 \text{ occurrence} \wedge D5 \text{ occurrence} \wedge D6 \text{ occurrence} \leftrightarrow E3.$

Each sample is a 7-dimensional vector of the state of the wine container representation design containing the elements 0 and 1. The values in dimensions 1 to 7 represent the state of the wine container representation design D0 to D6, where 1 means “occurrence” and 0 means “nonoccurrence.” Each sample has a label corresponding to the event attribute, with 0 indicating “unknown event,” 1 indicating E1, 2 indicating E2, and 3 indicating E3, thus constituting a label vector containing elements {0, 1, 2, 3}.

The main parameters of the OCSVM algorithm are $\nu = 0.01$, $\gamma = 0.3$, the kernel function is “radial basis (rbf)” function, and the rest of the parameters are selected by default.

Seven types of wine vessel representation designs, including D0 to D6, were used as normal sample classes, and a total of 500 samples from each class were taken as training samples. According to the rule set, the signal classes in this training sample are all wine vessel representation designs associated with cultural features.

A total of 100 samples were selected from each of the nine types of wine vessel characterization designs, including D0 to D8, to form test sample set 1; 100 samples were selected from each of the seven types of wine vessel characterization designs, including D0, D1, D2, D5, D6, D7, and D8, to form test sample set 2; and 100 samples were selected from each of the seven types of wine vessel characterization designs, including D1, D2, D3, D4, D6, D7, and D8, to form test sample set 3. The judgment results of test datasets 1, 2, and 3 are shown in Tables 7–9, respectively.

In this study, consider the training samples contain a certain proportion of data and each class of signal change state is more, the model is not stable enough, so in the same set of test data, more than half of the samples are detected; then, the group of samples will be considered, that is, set the judgment threshold accounted for 0.5.

Test sample set 1-3 through the judgment, all can be D7 and D8 two kinds of nonrelevant spectrum data filtered out, each group of test samples remaining samples as the wine ware characterization design correlation recognition test data. The experimental results show that there is a good detection effect for the class or nontraining set of signals.

The middle of the neural network uses two hidden layers, the number of neurons are 512 and 256, the decay rate of each layer is 0.999, batch – size = 16, epoch = 3000, the learning rate is 0.0001, and the excitation function is relu function. The confusion matrices of correlation results for test sample sets 1, 2, and 3 are shown in Figures 11–13.

For test sample 1, the lowest correlation accuracy among all test data classes was 94%, corresponding to the wine vessel representation design D2, and the rest were greater than or equal to 98%, and the correlation accuracy of D1 and D6 reached 1. For test sample 2, the lowest correlation accuracy among all test data classes was 88% for D2, and the best correlation result of 100% was achieved for D1. For test sample 3, the lowest correlation accuracy was achieved for the wine ware representation design D2 with a value of 85%, while the rest were no less than 95%.

The wine vessel representation design was associated with cultural features as follows. Training samples: the

constructed rule base data of wine vessel representation design and event association are used as training samples, including samples and labels.

Test samples: the results of the test sample sets 1, 2, and 3 after correlation and identification were processed according to the method in Section 3.3.2F to obtain the wine vessel representation design state vectors $\{1, 1, 1, 1, 1, 1, 1\}$, $\{1, 1, 1, 1, 0, 0, 1, 1\}$, and $\{0, 1, 1, 1, 1, 0, 1\}$, respectively, as test samples. The results of the wine ware representation design and event association are shown in Table 10. All of the test samples in Table 10 were predicted correctly, which showed the effectiveness of the method.

5. Conclusion

Ancient peoples were both artistic and practical in their drinking vessels. During their long careers, the ancients used their ingenuity to create many simple, beautiful, and durable production and living utensils, achieving the state of “making things with spirit and beauty.” The culture of artifacts can represent a country’s history and level of cultural development, and it is because wine played an important role in ancient Chinese society that wine vessels were highly valued and respected. As the material carrier of wine culture, wine utensils embodied plastic art, craft production, customs and habits, social functions, social hierarchy, etc. and thus were a concrete expression of spiritual and institutional culture. As a necessary apparatus for drinking wine, it is an important element to be studied first of all in the study of wine culture. Based on ML and semiotic theory, this paper deeply explores the correlation between the representational design and cultural characteristics of ancient Chinese drinking vessels, which well provides a theoretical basis for subsequent research.

Data Availability

The dataset used in this paper is available from the corresponding author upon request.

Conflicts of Interest

The authors declared that they have no conflicts of interest regarding this work.

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