J. COMBIN. MATH. COMBIN. COMPUT. 125 (2025) 2695--2712

Journal of Combinatorial Mathematics and Combinatorial Computing
www.combinatorialpress.com/jcmcc

Combinatorial Press

A Decision Tree Analysis Approach to Traditional and Modern Design Elements in Rural Landscaping

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Abstract: According to the connotation of traditional and modern design elements in rural landscape beautification, multi-dimensional data cube mining method is adopted to construct the research data set of this paper. According to the ratio of 2:8, the data set is divided into test set and training set. The data of traditional and modern design elements are used as inputs, substituted into the decision tree model for training and classification, and the CART algorithm is used to construct a decision tree model for traditional and modern design elements in rural landscape beautification. Combining the dataset and the model in this paper, the simulation analysis of traditional and modern design elements in rural landscape beautification is carried out. The data show that based on the Gini index calculation formula of CART algorithm, it is concluded that the Gini index of X9 (0.9581) is the largest, so X9 is chosen as the root node for decision making, and the decision tree is derived downward until the leaf node, and the decision tree oriented to the countryside landscaping is obtained, and the rural landscape beautification scheme is induced based on the results of the analysis and the effect of the rural landscaping is found to have the difference between the before and after mean values of 3.36 (20.11-16.75=3.36), while there is a significant difference between the two, similarly, there is also a significant difference in the building living comfort above. This study enhances the effect of rural landscape beautification, which is of great significance in promoting rural revitalisation and architectural design development.

Keywords: CART algorithm, decision tree, square body mining technology, rural landscape; architectural design

1. Introduction

As an ancient civilisation, traditional villages are one of the birthplaces of China's long-extended history and civilisation, which contain rich and long-lasting cultural heritage and thick vernacular landscapes, and are a powerful testimony to the harmonious coexistence of Chinese agricultural development and nature [1-2]. Traditional village rural landscape research elements include topographical elements, architectural elements, landscape environment, plant elements, and the

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Received 12 February 2024; Revised 20 April 2024; Accepted 25 December 2024; Published Online 15 April 2025.
DOI: 10.61091/jcmcc127a-152

historical and cultural elements they contain [3-4]. Traditional villages are like a photolithography machine, recording the original culture of Chinese village development, witnessing the development and change of society, and containing rich historical significance and economic value [5-6].

The integration of traditional culture makes the rural landscape design more in line with the local regional characteristics and humanistic atmosphere, creating a unique rural landscape [7-8]. By means of restoring the traditional architectural style and protecting the historical and cultural heritage of the countryside, it is possible to create rural landscapes with unique charms and enhance the beauty and cultural value of the human habitat. Incorporating traditional art, folk activities, traditional crafts and other elements of the countryside in landscape design can evoke the residents' sense of identity and belonging to traditional culture, enhance the cultural self-confidence of the countryside, and then enhance the residents' sense of well-being. It can also enhance people's sense of cultural identity and self-confidence [9-10]. At present, with the acceleration of urbanisation, traditional culture in the countryside faces the risk of marginalisation and decline. Incorporating traditional culture into rural landscape design can allow residents to reacquaint themselves with and identify with their own cultural traditions, and enhance their sense of cultural identity and self-confidence. This helps to cultivate residents' cultural self-consciousness and self-esteem, and promotes the cultural renaissance and development of the countryside [11-12].

The implementation of the new rural landscape planning and design project is even more significant as it helps to improve the rural ecological environment, promote the structural adjustment of the agricultural industry, enhance the ability of comprehensive agricultural production and development, beautify the appearance of new rural villages, and promote the harmonious coexistence of man and nature. At the same time also for rural areas to carry out folklore, sightseeing tourism industry and farmers through the new rural landscape construction to expand employment has also laid a good foundation, has important economic and social significance [13-14]. However, China's vast area, China's countryside due to their different geographical location, topography, landforms, soil, climate, vegetation, economic level and regional culture, presenting different rural landscape style. With the impact of economic transformation and urbanisation construction, people's concern for the specific living environment of rural residents and rural landscape features has gradually faded with the single-minded pursuit of material life [15]. One-sided pursuit of economic benefits and blind construction, more people ignore the original natural landscape of the countryside and the protection of the ecological environment, even if there are places in the new rural landscape construction to consider the protection of the natural landscape and the ecological environment, but in the form of landscape design language is obsolete, or the original form of the traditional copy of the original form of the lack of traditional forms and the modern modelling language of the ingenuity of the combination of the countryside in China by the "Traditional rural landscape to modern rural landscape" in the process of transformation of many deformed development phenomena [16-17].

Traditional villages themselves have many things worth protecting and inheriting, under the impact of beautiful countryside construction and new rural construction ideas, under the cultural protection and inheritance and economic development, how to retain the unique local regional culture, relying on the original natural environment and humanities to form a unique traditional unification of the village landscape features are facing new challenges.Chen, W explored the traditional and modern design elements in the village landscape design, and explores the problems that exist in it, which provides an important reference for optimising traditional and modern design elements in rural landscape design [18]. Yixiao, H. U et al. based on rural landscape elements and urban garden cases, clarified the principles of landscape design of cultural square parks in speciality towns as well as the planning ideas, which made a positive contribution to the creation of vernacular landscapes [19]. Markuszewska, I based on interview data related to future changes in vernacular landscapes reveals that there are differences in individuals' perceptions of traditional rural landscapes, i.e., personal interests drive people to take action on the departure or retention of rural landscapes [20]. Sun, B et al. examined how virtual reality technology plays a role in the field of rural tourism landscape design and concluded that virtual reality technology optimises the rural landscape tourism experience and can be vigorously pursued in terms of improving the rural landscape tourism experience [21]. Dezio, C et al. example investigated the role played by landscape design in enhancing territorial resilience, especially the impact on the implementation of agricultural models orientated by landscape design and tourism, which helped scholars to deepen the cognitive understanding of landscape design [22]. Daoyong, L. I et al. combined field research and questionnaire methods to explore design approaches on how to improve the quality of rural settlement landscapes, including proposing a landscape design framework based on rural architectural landscapes and habitat landscapes [23].

With the booming economic development in China in the past 30 years, the development process and scale of cities have accelerated, and at the same time, the pace of urbanisation is spreading rapidly to the countryside. The object of landscape design activity is rapidly expanding from the original single city to the countryside. As a result, China's rural landscape and settlement landscape have undergone radical changes, which is also a historical fact and inevitable.Qin, F introduced particle swarm optimisation algorithm strategy in the study of modern landscape design in the countryside to achieve intelligent configuration of rural land planning, lighting, and crop irrigation [24]. Montero-Parejo, M. J et al. attempted to assess how image complexity affects image quality through a practical case study, which in turn clarified the logic of the choice of stone and wood decorations in the rural architectural landscape, and the results of the study showed that the simple use of natural materials is not enough to guarantee the design quality of the façade [25]. Liu, Y et al. used Chinese elemental symbols and were guided by the concept of beautiful countryside to explore the development path of new rural landscape design, which effectively supplemented the Chinese rural cultural elements in the modern landscape design of new rural areas [26]. Chen, S elaborated that in the context of the rapid development of rural tourism, rural tourism landscape design should observe the concept of sustainable development, scientifically construct rural landscapes to reflect the ecological and humanistic values of rural landscapes, and established the principles and strategies of rural landscape design, aiming to ensure the coexistence of the natural beauty and humanistic traditions of rural landscapes [27]. Zhang, X et al. conducted a survey to explore residents' preferences for rural and modern landscapes, and based on the results of the survey, it was learnt that urban residents preferred vernacular landscapes, townspeople were fond of modern landscapes, and rural residents favoured transitional landscapes [28].

The innovation of this project is to use multi-dimensional data cube mining technology to obtain research data, which is more comprehensive and accurate, and at the same time, considering the complexity of the data of traditional and modern design elements, it is proposed to construct a decision tree model based on the CART algorithm for traditional and modern design elements in rural landscape beautification. According to the connotation of traditional design elements in rural landscape beautification, the attributes of traditional design elements in rural landscape beautification are determined, and the research dataset based on multi-dimensional data cube mining is produced. Setting up the experimental environment and the control algorithm, the CART algorithm is simulated and analysed in combination with the dataset. Using the CART algorithm to calculate the Gini index of each design element attribute, based on the results of the Gini index of each design element attribute, complete the decision tree construction task for the traditional and modern design elements in rural landscape beautification, and put forward the rural landscape beautification programme, and validate the integration of traditional and modern design elements on the rural landscaping of the countryside before and after the landscaping effect and the comfort of the building through the independent samples of rural landscaping before and after the landscaping effect and the comfort of the building to verify the integration of traditional and modern design elements. Through the independent sample test on the beautification effect and building living comfort before and after the rural landscape beautification, we verify the promotion effect of the integration of traditional and modern design elements in the rural landscape beautification for rural revitalisation.

2. Traditional and modern design elements in rural landscape beautification

2.1. Traditional Design Elements in Rural Landscaping

2.1.1. Connotation of traditional design elements. Traditional design elements refers to the oriental elements of the Chinese nation, involving culture, religion and philosophy and other areas of content, in the process of long-term development has formed a certain characteristic cultural types [29]. Traditional elements are integrated with the development of art, which can reflect the inheritance of history and show the characteristics of the Chinese nation, with the characteristics of the times and the region. For example, the Great Wall of China and the Mausoleum of Qin Shi Huang contain the historical culture of the Chinese nation and show different cultural characteristics. In the traditional elements, including morality, folklore and ideology, each of which can present unique cultural concepts, applying them to the field of modern architecture brings a strong influence and is an important way to show the traditional Chinese cultural style. By integrating the classical, free and peculiar characteristics of traditional elements into the design, it can make the design more energetic and permeate the breath of history and culture, showing the corresponding cultural charm.

2.1.2. Traditional design elements and their classification. Traditional Chinese design elements include many, which can be roughly divided into traditional decorations, painting and calligraphy art elements, ancient architecture design elements and so on. When using traditional Chinese design elements, it not only injects the designer's own aesthetic experience, but also reflects the views and attitudes of the society at that time towards the beautification of rural landscape and their own needs. Therefore, Chinese traditional elements not only reflect the designer's own aesthetic ability, but also carry an important carrier of social culture.
1) Classification according to material form. If traditional Chinese design elements are classified according to their material forms, they can be divided into tangible and intangible elements.

(1) Tangible elements. Tangible elements can be divided into elements that take the rural landscape as the design theme, such as writing, calligraphy and guqin. In addition, there are some culturally significant mythological stories and some well-known anecdotes of celebrities in China, which can be represented as tangible elements.

(2) Intangible elements. Intangible elements reflect the spirit and cultural connotation behind the tangible elements. Intangible elements have the following manifestations: firstly, design elements based on the theme of traditional Chinese festivals, secondly, elements of living habits, thirdly, traditional philosophical elements, fourthly, design elements of regional culture, fifthly, elements of cultural texts, and sixthly, elements of religion and art.
2) Classification according to the content of expression. Figure 1 shows the illustration of traditional design elements, which is divided into seven categories: folk customs, auspicious objects, traditional culture, characters, art treasures, humanities, geographical coordinates and so on. The classification of traditional Chinese design elements in terms of performance content can also draw on this classification of Chinese elements. From the classification of Chinese elements, traditional Chinese design elements can be classified as follows. Firstly, the design elements related to animals and plants, as well as the animals evolved from animals and plants themselves, and put a certain degree of imagination, such as dragons, unicorns, etc. Secondly, the figures and the evolution of figures. Secondly, there are the characters and their evolved images, such as Confucius, Yellow Emperor, Zhong Kui and other characters as well as the variations of their portraits. There are also traditional cultures and festivals, such as calligraphy, Chinese painting and festivals. There are also natural scenery and

architectural elements. Finally, there is a category of man-made artefacts, such as porcelain, jade and abacus.

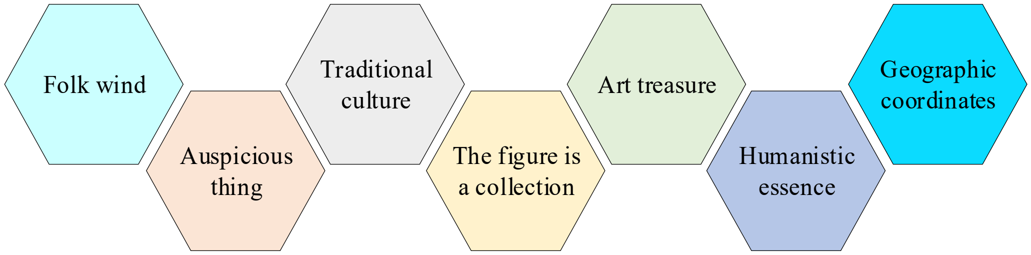


Fig. 1. Traditional design element legend

2.2. Modern design elements in rural landscape beautification

The actual expression of modern design elements is dominated by colour composition, plane composition and three-dimensional composition, which is also the core of design. These three elements can be used independently or integrated in rural landscape beautification.

2.2.1. Colour composition. The importance of colour composition for rural landscaping can not be said to be unimportant, colour theory based on the use of people's psychological defences can be lowered to strengthen the sense of comfort. Light colours are more relaxed, heavy colours are more heavy, rural landscaping for the grasp of the colour must be reasonable, the sense of lightness of the colour to give the overall impression of people can even determine the good or bad of the garden art. The law of colour light and heavy sense of grasp to white (light) as the first, followed by high brightness, medium brightness, low brightness and black (heavy) based on the purity, there are also low purity than in the purity of lower than the perception of high purity. This is a high brightness light colour system for the main expression of lightness, low brightness dark colour system can reflect the sense of stability is also in the colour matching and design to show the overall coordination.

2.2.2. Graphic composition. Relative to the colour composition, the plane composition is more to show the utilization rate of visual sense, as a sense of perception under the joint action of the composition of the biography, the use of design concepts for the grasp of the elements, with reasonable logical thinking ability for the overall concept, in order to initially determine the desired effect. Plane composition is mainly based on points, lines and surfaces. Although the point of the composition of this factor in the plane composition of the direct use of the rate is not high, but it has the multilateral nature is rare design elements, points can be used as a convergence point of the eyes, the countryside landscape landscaping as a whole to promote the visual centre of the graphic design, in order to achieve the effect of the theme to highlight the mood of the creation of the effect.

2.2.3. Cubic composition. Three-dimensional composition is mainly expressed in lines, the most important feature of the line lies in the length, the countryside landscape landscaping in the two essential lines, namely, curves and straight lines. In the way of expression is mostly horizontal line, vertical line and inclined line. Straight lines are mostly used in green belts and regular countryside landscaping. Horizontal lines have a very high usage rate due to their stable and single characteristics. Curve is also more common in rural landscaping, and the reasonable use of curve and straight line strengthens the visual impact and sensory experience of rural landscaping.

3. Decision tree analysis model

3.1. Data set acquisition

3.1.1. Prerequisites for Design Element Mining. In the face of the huge amount of diversified information brought by the information age, it is necessary to firstly decompose and refine the most basic design elements in the vast ocean of information as a prerequisite for research and analysis. According to the above overview of traditional and modern design elements in rural landscape beautification, it can be seen that the traditional and modern design elements of rural landscape beautification mainly include: folk customs, auspicious objects, traditional culture, characters, art treasures, humanities, geographical coordinates, colour, plane, three-dimensional above ten categories.

3.1.2. Multidimensional data cube mining. According to the rules of cube construction, this paper establishes a data cube of traditional and modern design elements of four-dimensional rural landscaping based on time, source, style and type, which includes 24=16 cubes, and the layout of these 16 data cubes is as follows: the cube summarized at the lowest level is the basic cube, which is a four-dimensional basic cube composed of "time-source-style-type". Above is a collection of three-dimensional cubes composed of "Source-Style-Kind", "Time-Style-Kind", "Time-Source-Type", and "Time-Source-Style". And so on, the topmost and topmost set is called the vertex cube.

The derivation of the cube establishment rule is shown in Figure 2. According to the derivation of the square body establishment rule, the data of traditional and modern design elements of rural landscape beautification consists of fourteen dimensional tables of time, source, style, type, folklore, auspicious objects, traditional culture, characters, artistic treasures, humanistic essence, geographical coordinates, colour, plane and three-dimensional. That is, it forms a fourteen-dimensional cube which has 214 = 16,384 cubes. In this paper, for the multi-dimensional data mining of branded knitwear design information, 214 cubes will be mined, and if a dimension presents a multi-level structure, data mining can be carried out according to the need for different levels of dimensions, and ultimately obtain a data set of design elements in 10 areas, including folklore, auspiciousness, traditional culture, etc.

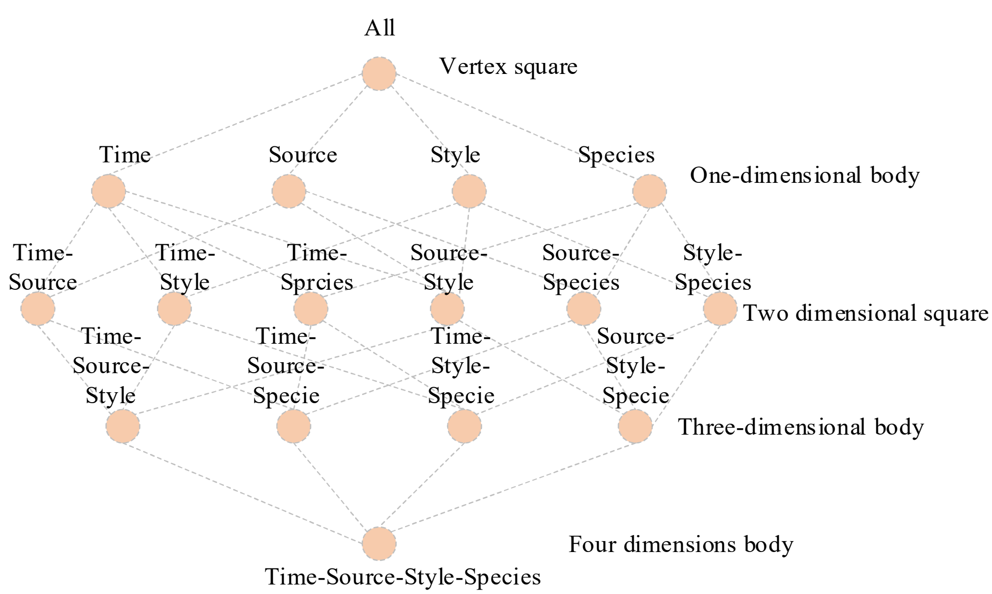


Fig. 2. The square body establishes the rule derivation

3.1.3. Data sets. As there is no dataset of traditional and modern design elements for rural landscape beautification, it needs to be produced by itself. In the process of marking information there may be cases of failing to mark correctly, or there may be cases of marking information incorrectly, which can be optimised and sorted out in the process of data pre-processing. The data of 16384 traditional and modern design elements of rural landscape acquired above are adjusted. According to the principle of 2:8 ratio, 13107 design element data are used as the training set, while the remaining 3277 design element data are used as the test set, and then the data set of traditional and modern design elements of the rural landscape are used to meet the requirements of the experimental data, and the construction of the data set is completed.

3.2. Mathematical modelling

3.2.1. Overview of decision trees. The Decision Tree Algorithm (DT), as a machine learning method based on inductive reasoning about data, employs a form of conditional judgement logic similar to If-Else to classify its core classification ideas [30-31]. The decision tree algorithm model is shown in Fig. 3, this effective partitioning strategy, when given an input, applies traversal at each branch node, repeating recursively until it loops to the final terminal leaf node. In decision tree composition, it mainly consists of a root node, multiple internal nodes, and multiple leaf nodes. These nodes have a one-to-one or one-to-many mapping relationship, corresponding to the object attribute Key and the object value Value at different nodes, where the root node contains all the training sample sets (test set, validation set). A branch from the root node (RN) to each leaf node (LN) corresponds to a rule for decision making. The leaf nodes under the decision tree then correspond to the final decision result. Each internal node is equivalent to a conditional judgement process, the sample set will be divided into the corresponding left son node or right son node according to the conditional judgement result of the parent node. Because the final filtering conditions of different branching results are shaped like tree trunks and branches, so it is called a decision tree.

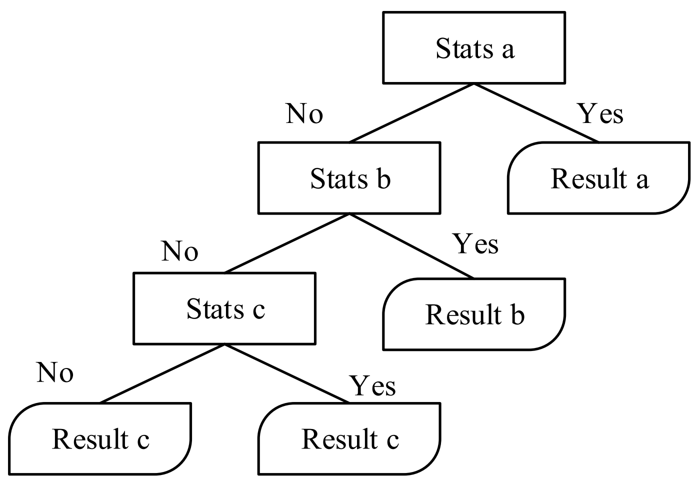


Fig. 3. Decision tree algorithm model

3.2.2. Decision tree construction. The decision tree construction process is shown in Figure 4. In the first step, the design element sample set is trained and screened to find out the most eligible attribute as the first node, i.e., the root node. In the second step, the decision tree algorithms such as ID3 algorithm, C4.5 algorithm, CART algorithm and other related algorithms are used to calculate the basis of dividing the test attributes of different categories of samples to divide the attributes. In the third step, labelling of classification attribute values is carried out for the branches that establish links between the root node, internal nodes and leaf nodes. Step 4, repeat the above steps until all nodes are divided. In the fifth step, it is necessary to remove a part of the branch subtree that is not very accurate and helpful in classifying the dataset, and replace it with leaf nodes, this process is called pruning.

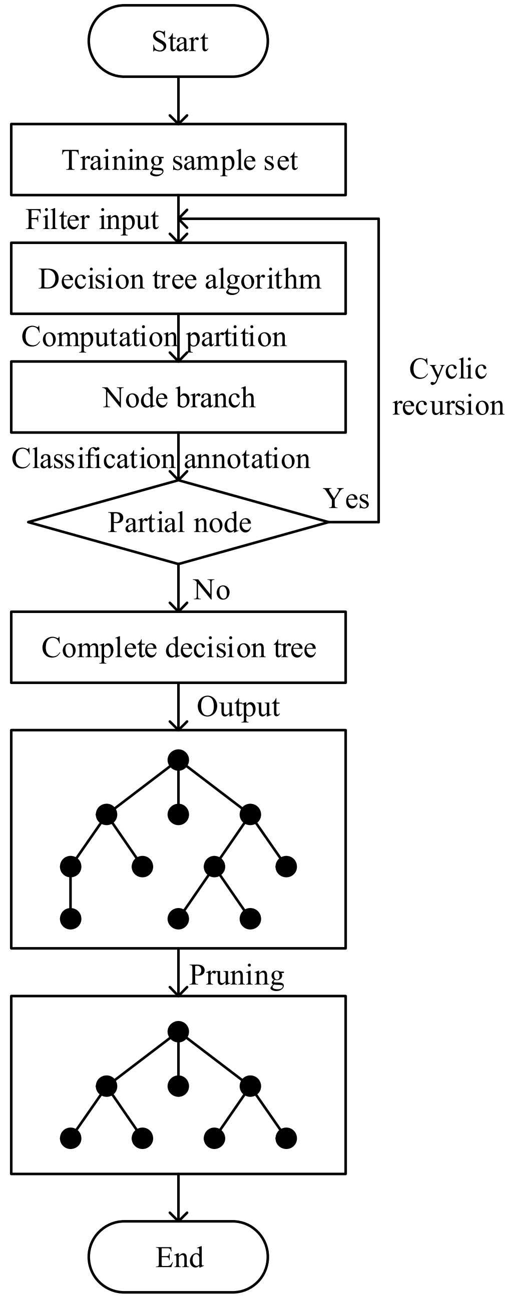


Fig. 4. Decision tree build process

3.2.3. CART algorithm. The essence of decision tree learning is through a class of irregular training set, the division of inference out of the more pure subset, in a circular recursive way to build a decision tree. Nowadays, the most popular and typical decision tree algorithms are ID3 algorithm, C4.5 algorithm, CART algorithm, etc. Considering the complexity of traditional and modern design elements in rural landscape beautification, this paper adopts CART algorithm for this purpose.

The CART algorithm uses the Gini index as a criterion to classify the dataset, which is based on the definition of the Gini coefficient, which is a probability value within the range of 0 and 1.

Its main role is to be applied as a classification performance evaluation index, when the value of Gini is 0, it means that the dataset remains consistent and there is no classification. When the value of Gini is 1, it means that the data set is obviously polarised and there is classification. If the sample dataset S contains M classification attribute categories, the specific Gini formula is shown in equation (1):

$$Gini(S) = 1 - \sum_{i=1}^{M} C_i^2 \tag{1}$$

where M is the number of categories for the current attribute test and C_i is the probability share of category i acquired in sample set S. If S is divided into S_1, S_2 two sample sets, respectively, the number of categories in their respective sub-sample sets is M_1, M_2 respectively, then the $GiniIndex$ formula calculated after being divided is shown in equation (2):

$$GiniIndex_{all}(S) = \frac{M_1}{M} Gini(S_1) + \frac{M_2}{M} Gini(S_2) \tag{2}$$

If there exists such a decision node T, where S_1 is part of the S sample set division, and there are left branch S_{le} and right branch S_n under the branch node of this node T, the formula for the Gini index subtraction is shown in equation (3):

$$Gini_{split}(S_1, T) = Gini(T) - \frac{|S_{le}|}{|S_{ri}| + |S_{le}|} Gini(T_{le}) - \frac{|S_n|}{|S_{ri}| + |S_{le}|} Gini(T_{ri}) \tag{3}$$

where $Gini(T)$ is the Gini coefficient calculated by the pre-division test. $|S_k|, |S_n|$ is the number of samples in the left and right branch nodes, respectively. In order to make T 'purity' better, the value of the Gini coefficient becomes the smallest, that is, the Gini index is reduced to the maximum. Specific branching formula as shown in equation (4):

$$\Delta Gini_{reduction} = arg\max_{S_1 \in S} Gini_{split}(S_1, T) \tag{4}$$

Where the Gini index minus the maximum is known from equation (5), i.e., the value of the left and right subtree summation is minimised and the formula is shown below:

$$\frac{|S_k|}{|S_{ri}| + |S_k|} Gini(T_{le}) + \frac{|S_{ri}|}{|S_{ri}| + |S_{le}|} Gini(T_{ri}) \tag{5}$$

If k feature category appears, the $Ginilndex$ calculation formula after being divided is shown in equation (6):

$$GiniIndex_{all}(S, k) = \sum_{i=1}^{M} \frac{|M_1|}{|M|} Gini(S_i) \tag{6}$$

From the Gini index $Ginilndex$, it is easy to see that when $Gimi$ is larger, the purity of the sample is lower. Conversely, the higher the sample purity.

3.2.4. Post-Pruning Strategy for Decision Trees. Let a certain leaf node is a leaf node that is considered pruning, there is N sample data under this node, in which the number of errors is W. At this time, it is necessary to introduce a penalty factor 1/2 to improve the overfitting problem of the decision tree, then the specific formula for calculating the error rate is shown in equation (7):

$$\frac{W + 0.5}{N} \tag{7}$$

If there is a total of K leaf node under the subtree, the error rate formula for the subtree is shown in equation (8):

$$P(K) = \frac{\sum_{i=1}^{k} E(N_i) + 0.5K}{N_i} \tag{8}$$

It is also known that the formula for the expected number of errors before pruning is shown in equation (9):

$$P_{bv} = N \cdot P(K) \tag{9}$$

From equation (9) expectation number before pruning, the formula for the standard deviation of the number of errors is shown in equation (10):

$$S_{be} = \sqrt{N \cdot P(K)(1 - P(K))} \tag{10}$$

If the pruning becomes a leaf node, the number of leaf nodes $L = 1$, then the formula for the expected number of errors after pruning is shown in equation (11):

$$P_{af} = N(\frac{E + 0.5}{N}) = E + 0.5 \tag{11}$$

And the pruning condition is that when one standard deviation of the number of misclassification of the leaf nodes under the subtree is less than the number of misclassification of the subtree, then it is pruned, and the specific formula is shown in equation (12):

$$P_{af} - S_{be} < P_{be} \tag{12}$$

4. Decision Tree Analysis of Rural Landscaping Design Elements

4.1. Experimental analysis of the CART algorithm

4.1.1. Experimental environment. This study uses a dataset of traditional and modern design elements for rural landscaping, which has been expressed above and will not be repeated here. The algorithm was implemented in Python and the experimental environment was Windows 11.0, Intel Corei7-4510CPU@2.60 GHz, and 4G byte of memory.

4.1.2. Experimental set-up. The ID3 algorithm is used in the control group, while the CART algorithm is used in the experimental group. The performance of the classification model is measured by the confusion matrix, which includes the measures of recall (sensitivity), recognition (accuracy), special effects (true negative rate), and precision. TP is true positive or true positive, which represents the number of positive samples that are predicted to be positive samples in the prediction of the classification model (the portion of the positive samples that are correctly classified). TN is true negative or true negative, which represents the number of negative samples that are classified as negative samples (the portion of the negative samples that are correctly classified) in the prediction of the classification model. TN is a true negative example or true negative, representing the number of negative samples that were classified as negative samples in the classification model prediction (the portion of negative samples that were correctly classified). FP is a false positive example or false positive, representing the number of negative samples that were predicted to be positive samples by the classification model (the portion of negative samples that were incorrectly classified). FN is a false negative example or false negative, representing the number of positive samples that were predicted to be negative samples by the classification model (the portion of positive samples that were incorrectly classified).

The recognition rate is the percentage of the samples correctly classified by the classification model to the overall, which reflects the correct recognition of the model to all kinds of samples, the higher the rate the better the classification model effect. The formula is as follows:

$$Accuracy = \frac{TP + TN}{P + N} \tag{13}$$

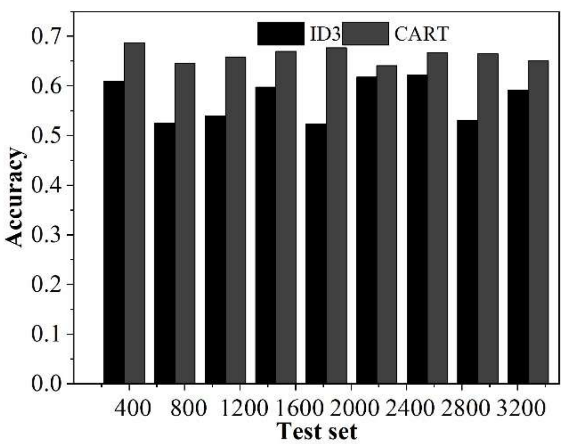
Recall reflects a measure of the model's precision in predicting positive samples, with a higher rate representing a stronger model's ability to predict positive samples. The formula is as follows:

$$\mathrm{Re}\,call = \frac{TP}{P} \tag{14}$$

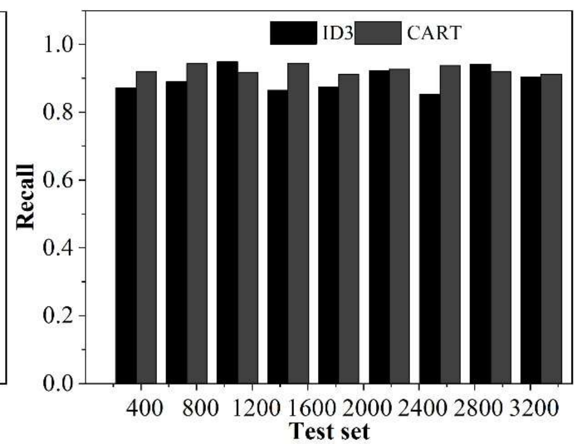
Specificity is the proportion of negative samples that are judged to be negative, i.e. the index of correct judgement of negative samples, which can evaluate the model's ability to identify negative samples. The calculation formula is as follows:

$$Specificity = \frac{TP}{P} \tag{15}$$

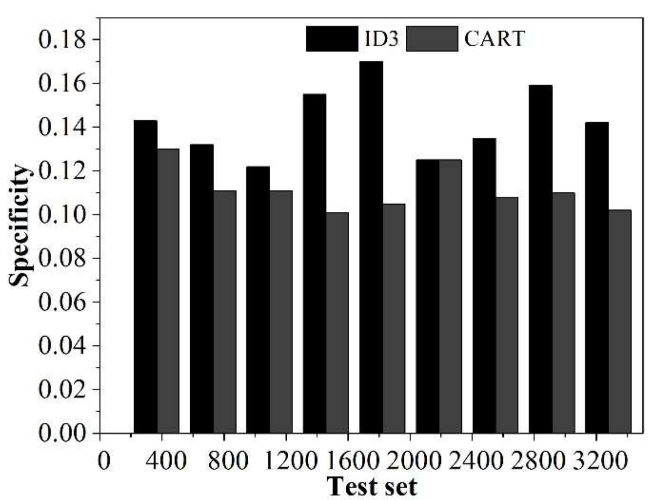
4.1.3. The effect of the number of test sets on the effectiveness of the model. The dataset for training the classification algorithm was tested and validated by substituting the data of 3277 design elements in the test set into the model, and a total of nine tests were conducted to obtain nine model classification results, and the effect of the number of test sets on the model effect is shown in Fig. 5, in which (a) to (c) are the recognition rate, the recall rate, and the special effectivity, respectively. Although the variation in the number of test sets makes the precision, recall, and special effects of the classification model prediction results produced by the two algorithms vary, the overall stability of the CART algorithm is higher than that of the ID3 algorithm. Specifically, the CART algorithm (0.663) had a higher recognition rate than the ID3 algorithm (0.573), and the CART algorithm (0.926, 0.111) also outperformed the ID3 algorithm (0.897, 0.143) in terms of recall and special effects.



(a) Accuracy



(b) Recall



(c) Specifictiy

Fig. 5. The effect of the test collection on the model effect

4.2. Establishment of decision tree for traditional and modern design elements

4.2.1. Results of Gini index calculations. Let the above dataset be $K+1$ vector $X:(X_1, X_2, \cdots X_k; Y)$, where $X_1, X_2, \cdots X_k$ becomes the predictor variable, Y is called the categorical variable, Y takes the value in $C = C_1, C_2, \cdots, C_n$, and C is called the class set.

Here, the attributes of traditional and modern design elements (folklore X1, auspicious objects X2, traditional culture X3, people X4, artistic treasures X5, humanistic essence X6, geographic coordinates X7, colours X8, planar X9, three-dimensional X10) are selected as the predictor variables, and the vocabulary describing the traditional and modern design elements of the countryside landscapes (green and lush Y1, birdsong and flowers Y2, staggering Y3, Clear water and green banks Y4, idyllic scenery Y5, simple and elegant Y6, evergreen in all seasons Y7, quiet and peaceful Y8, vibrant Y9, blue sky and clean water Y10) as categorical variables. Due to space limitation, the categorical variable Y1 and seven predictor variables (X4, X5, X6, X7, X8, X9, X10) are taken here for exploratory analysis, and the values of the relevant predictor variables and categorical variables are shown in Table 1. The samples with design element attributes greater than 0.5 are categorised as 'green' = yes. In the 12 samples, the categorical variables have 10 positive cases ('greenish' = yes) and 2 negative cases ('greenish' = no), according to the above Gini index formula, then the Gini index of the sample set is:

$$Gini(S) = 1 - \sum_{i=1}^{M} C_i^2 = 1 - \left[(0)^2 + (0)^2 + \cdots + \left(\frac{1}{7}\right)^2 \right] = 1 - 0.1429 = 0.8571$$

Table 1. The prediction variable and the classification variable

Sample point	X4	X5	X6	X7	X8	X9	X10	Y1
1	0	0	0	0	0	0.5	0	1
2	0	0	0	0	0	1	0.5	1
3	1	0.5	0	0	0	0.5	0	1
4	0	0	0	0.5	0	0	1	1
5	1	0	0	0	0	0.5	0	1
6	0.5	0	0	0	0	0	0.5	0
7	0	0.5	0.5	1	0	0	0	1
8	0.5	0	0	0	0.5	0	0	0
9	0	1	0	0	0.5	0	0	1
10	1	0	0	0.5	0	0	0.5	1
11	0	0	0	0.5	0	0	0	1
12	0.5	0.5	0	0	1	0.5	0	0

Taking X4 as an example, its corresponding Gini index is calculated and the results are as follows:

$$Gini(S) = 1 - \sum_{i=1}^{M} C_i^2 = 1 - \left[(0)^2 + (0)^2 + (\frac{1}{7}) \cdots + (0)^2 \right] = 1 - 0.0612 = 0.9388$$

The other predictor variables are the same, and will not repeat the calculation, and the final results are shown in Table 2. It can be seen that the Gini index of X4~X6 is distributed in the range of 0.9104~0.9581, which provides data support for the subsequent analysis of decision tree rules.

Table 2. Final result

Variable	X4	X5	X6	X7	X8	X9	X10
Gini	0.9388	0.9406	0.9104	0.9403	0.9542	0.9581	0.9125

4.2.2. Decision tree rule analysis. The decision tree rule analysis is shown in Fig. 6, here the variable X9 has the largest Gini index, so we choose this attribute variable as the root node of the decision, and the decision tree is derived downwards until the leaf nodes. The last step in building the decision tree is the derivation of the rules. We can get to a rule from each branch of the decision tree, and finally get the decision tree model for rural landscape beautification. In this paper, the CART algorithm is used to calculate and compare the Gini coefficient of each attribute, so as to construct the decision tree for rural landscape beautification, which provides a theoretical basis and implementation method for rural landscape design under the concept of rural revitalisation.

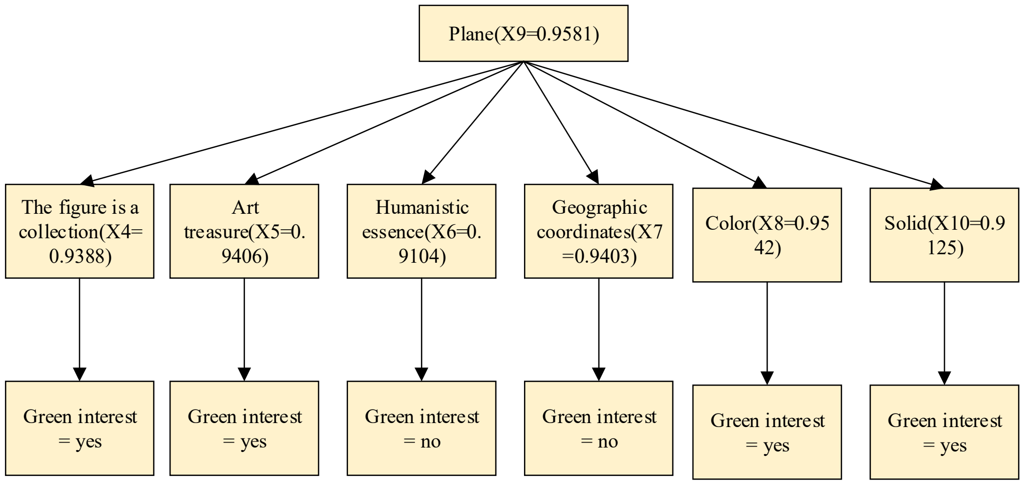


Fig. 6. Decision tree rule analysis

5. Example analysis of rural landscape beautification

This section firstly gives a specific rural landscape beautification scheme based on the results of the decision tree analysis, and examines the feasibility of this beautification design scheme from the two aspects of beautification effect and architectural habitation adaptability, aiming to promote the rural landscape and architectural design.

5.1. Rural Landscaping Programme

Based on the results of the above decision tree analysis, modern design elements (colour X8, plane X9, three-dimensional X10) and traditional design elements (characters X4, artistic treasures X5) are integrated into the rural landscape beautification, which is mainly embodied in the non-heritage cultural experience centre, as detailed below:

1) First of all, optimise and upgrade the doors and windows of the building, the original door frames and windows are wooden, after a long time of seawater and sea breeze erosion has been dilapidated, the material of the door frames, doors and windows will be replaced with rusty-red weather-resistant steel plate, the use of modern materials and the combination of the local traditional masonry materials design techniques, to form an echo of the new and the old In addition, reopen the windows and doors on the walls of the building, the original windows and doors are too small, affecting the lighting inside the house, expand the windows and doors. The original windows and doors were too small, affecting the lighting inside the house. Expanding the size of the windows and matching them with transparent glass optimises the lighting inside the building and opens up the view of the interior and exterior.

2) The courtyard was originally deserted and overgrown with weeds. After removing all the weeds, the landscape in the courtyard was re-planned and designed. Courtyard landscape design in accordance with the site of the Taoist culture in the design elements of the Bagua, to the courtyard entrance to the gate of the road will be divided into two parts of the courtyard, in the Bagua is divided into yin and yang fish, which echoes the site of the overall landscape design ideas, and directly increase the site's cultural resilience.

3) In the courtyard on all sides of the fence to open the prototype window holes, on the one hand is to break the original closed fence cautious and serious atmosphere of the site, on the other hand is to increase the landscape, people, the site of the linkage between the three, from the outside of the fence to the inside, different angles present different although the picture, from the inside of the courtyard to the outside, but also another view.

5.2. Landscaping effects in the countryside

Through the distribution of questionnaires to obtain the quantitative value of the effect of rural landscape beautification before and after, the quantitative value of independent samples t-test, the results of the comparative analysis of rural landscape beautification before and after are shown in Figure 7. Based on the data in the figure, it can be seen that the quantitative value of the effect of rural landscaping before beautification is 16.75±3.15, while the quantitative value of rural landscaping that integrates traditional elements and modern elements is 20.11±3.02, and the difference between the two means is 3.36 (20.11-16.75=3.36), and there is a significant difference between the two (P<0.05, T=1.347), the rural landscaping that integrates traditional elements and modern elements is more favourable to the countryside. Elements and modern elements of rural landscape beautification is more conducive to the promotion of rural revitalisation, and has an important guiding value for the sustainable development of rural cultural tourism.

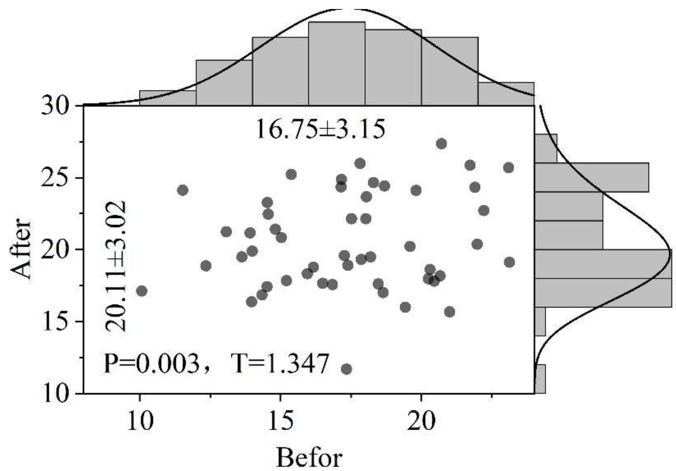
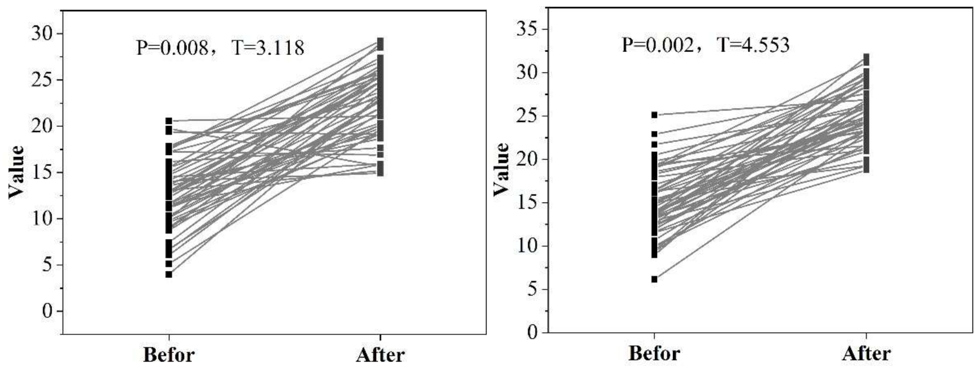


Fig. 7. The rural landscape beautification is compared and analyzed

5.3. Rural Building Residential Comfort

This subsection explores the living comfort before and after rural landscaping from the two dimensions of temperature and scenery, the data of which are obtained from a website, and the results of the independent samples t-test of living comfort in rural landscaping are shown in Fig. 8, in which (a)~(b) are the temperature and scenery, respectively. Based on the data performance in the figure, it can be seen that the size of the temperature and scenery values before and after the beautification of the countryside landscape are 12.68±4.11 (22.09±3.68) and 14.67±3.99 (25.32±3.82), respectively, and the values inside the parentheses are the results after the beautification. There were significant differences in temperature and scenery before and after landscaping the countryside (P=0.008, P=0.002), and after landscaping the countryside, the comfort of living in the building was significantly improved.



(a) Temperature (b) Landscape

Fig. 8. Rural landscape beautification of residential comfort comparison analysis

6. Conclusion

This paper introduces the categories of traditional and modern design elements in rural landscape beautification, uses multi-dimensional data cube mining technology to obtain the research data set of this paper, and divides the data set into test set and training set according to the ratio of 2:8. Put the data set into the decision tree algorithm for iterative training, output the Gini index results, according to the Gini index of the design elements to construct the model of this paper, the use of simulation experiments to verify the model of this paper analysis. According to the Gini index calculation formula, the Gini index values of the characters X4, artistic treasures X5, humanistic essence X6, geographical coordinates X7, colour X8, plane X9, three-dimensional X10 are 0.9388, 0.9406, 0.9104, 0.9403, 0.9542, 0.9581, 0.9125, respectively, and the final Gini index value is 0.9388, 0.9406, 0.9104, 0.9403, 0.9542, 0.9581, 0.9125, respectively, based on the design element's Gini index, the decision tree for rural landscape beautification is constructed to provide theoretical data guidance for the rural landscape beautification project. Based on the results of the decision tree analysis, the rural landscape beautification scheme is given, and a comparative analysis of the rural landscape before and after beautification shows that there is a significant difference between the beautification effect and living comfort before and after the rural landscape beautification, indicating that the integration of traditional elements and modern elements of the rural landscape beautification is more conducive to the sustainable development of the rural cultural tourism.

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