Research on Modern Design of Green Buildings Based on Big Data Technology

Zhanguo Hao[1] and BuYin Ao qi er[2*]

[1,2]School of Architecture, Inner Mongolia University of Technology, Hohhot 010051, China
Zhanguo_Hao2022@163.com

Corresponding author: BuYin Ao qi er, gd666168@163.com

Abstract. In order to explore the intelligent algorithms that can be used in the modern design of rural green buildings, this paper conducts factor analysis based on the modern design requirements of rural green buildings, and constructs a data mining algorithm suitable for factor analysis of rural green buildings on the basis of quantitative analysis. Data mining technology uses energy consumption software to simulate and analyze the energy consumption of the building, calculate the energy consumption in the normal operation stage, and calculate the corresponding energy consumption and multiply it by the carbon emission factor of the corresponding energy to derive the carbon emissions during the operation phase. In addition, this paper combines the actual situation of rural green buildings to conduct a multi-faceted architectural case analysis, and combines the actual situation to construct a system functional structure. Finally, this paper verifies the method proposed in this paper through experimental research. From the research results, it can be seen that the method proposed in this paper has a better effect.

Keywords: Big data technology; rural area; green building; modern design
DOI: https://doi.org/10.14733/cadaps.2023.S15.1-16

1 INTRODUCTION

Energy, as the material basis for human survival, has always been valued by all countries in the world. Moreover, the depletion of energy resources is a major problem facing all mankind. Although my country has abundant fossil energy resources, its large population leads to a relatively small amount of resources per capita. In recent years, the total energy consumption of China's construction industry has increased year by year, and the proportion of energy consumption in the construction industry in the country's total energy consumption has been increasing year by year. The growth rate of building energy consumption will directly affect China's economic development process. If we do not pay attention to the design and promotion of building energy efficiency, it will directly aggravate the energy crisis in our country. Therefore, in order to achieve sustainable development in my country, it is necessary to increase the importance of building energy conservation, and at the same time increase the research and promotion of energy conservation in the construction industry [1].

China's long-term urban-rural dual structure has made rural construction lack sufficient attention and attention. At the same time, due to the low level of the rural economy, the rural areas are backward and the environment is dirty. For a long time, rural construction has been mainly based on farmers' self-construction, and lack of technical support and standardized supervision has led to the lack of guarantees for residential safety and relatively poor living comfort. Moreover, residential planning and management are lagging behind, resources are wasted seriously, and supporting facilities are incomplete. Therefore, the construction of a new countryside is a major measure to change this status quo [2]. However, there are many problems in the construction of new rural areas while achieving greater results. Researching and solving existing problems is of great significance to the advancement of my country's new countryside construction, and at the same time, it can also improve the level of my country's new countryside construction. As a large agricultural country, China's new rural construction has the characteristics of wide range and huge volume [3].

The construction of a new countryside should learn from the lessons of resource consumption and environmental pollution brought about by rapid urban development and construction, take an intensive development path, and introduce the concept of sustainable development into the construction of a new socialist countryside. At present, most of the research on the construction of new socialist countryside has focused on the construction model and policy recommendations in the social and ecological environment, and many results have been achieved. However, there are very few studies on the construction of green new countryside. The study on the construction of new countryside in Poyang Lake Eco-economic Zone based on green building technology has great and far-reaching significance for the construction of new countryside in Poyang Lake Eco-economic Zone and Jiangxi Province. It provides theoretical guidance and technical support for the construction of new countryside in the region. The construction of new countryside that is extended to areas with similar climates has certain reference value for how to build a better and more ecological new countryside. The planning and construction of new rural communities is an important form and component of the construction of new rural areas, and the maximum benefit of resource utilization is achieved by integrating land. The use of green building technology for the construction of new rural areas, first of all is to integrate land, plan communities, and allow villagers to live together, which can save land resources, power grid resources, and reduce road hardening mileage. The use of green building technology to build resource-saving new rural communities can save a lot of resources across the country, and can greatly promote the process of building a conservation-oriented society in my country. The second is residential design, supporting infrastructure construction and the use of some renewable resources. This can greatly improve the rural environment, enhance the comfort and safety of farmers' living, and the convenience of life, and achieve the ultimate goal of improving the overall living standards of farmers.

Based on the above analysis, this paper uses big data technology to conduct data mining on the modernization of rural green buildings, constructs the corresponding system structure, and analyzes the rural green modern design, so as to improve the modern design effect of rural green buildings.

2 RELATED WORK

The concept of "eco-village" has developed rapidly in European countries and has a profound impact on European rural housing construction. European countries formulate and implement rural development plans from the perspective of long-term development to improve the living environment, production and life of farmers. It mainly includes rural industrial planning, research and development of new building materials suitable for rural housing, and the perfect construction of public infrastructure [4]. Through the transformation of villages and towns in Germany, the overall landscape is harmonious and beautiful. At the same time, some construction companies also provide complete sets of prefabricated components for the construction of rural houses. Moreover, Germany pays more attention to the low-carbon energy-saving of rural housing, which is reflected in the housing envelope, new technologies and the use of new energy. In addition, the government has also formulated a rural solar energy promotion plan [5]. The Netherlands used land rectification to make neatly planned new rural villages to replace the former natural villages. Poland attaches importance to the independence of rural houses, and emphasizes the maximum satisfaction of living comfort in the basic design of detached houses [6].

Green buildings have been widely promoted in urban areas due to energy conservation, environmental protection, and high indoor comfort. However, there are few applications of green buildings in the vast rural areas. The main reasons for this include the following: green building construction has a higher investment cost than traditional buildings, has not been actively promoted in rural areas, lack of cooperation and coordination between various departments, and villagers' adherence to traditional building patterns, etc. These reasons have made the development of green buildings in rural areas of various countries very slow [7]. Moreover, rural green buildings are currently at the stage of proposing concepts, and existing research is mainly focused on the promotion of rural green building concepts [8] and related measures for rural green building development [9]. However, under the premise of the rapid development of urban green buildings, as well as my country's existing national conditions and the development of new rural construction, the in-depth study of socialist new rural green buildings will surely become one of the future research hotspots. In addition, a very important point in the research of rural green buildings is to optimally solve the energy demand of farmers at the lowest possible cost, which is of great significance for the future promotion and implementation of rural green buildings [10].

The literature [11] took rural new green buildings as the research object, and pointed out that new green buildings can meet their winter heating, daily hot water, gas and other energy needs through renewable energy, and save energy and reduce emissions. Moreover, it has verified the economic feasibility of new rural green buildings through examples. In order to achieve the purpose of energy saving and emission reduction of rural green buildings, the literature [12] gave feasible suggestions on several key considerations in the design and construction of new rural green buildings, which provide a reference for the development of new rural green buildings. The literature [13] studied the incremental costs and benefits of green buildings from the perspective of the full life cycle of buildings, and verified the feasibility of green buildings from the observability of economic benefits, social benefits, and environmental benefits through examples. The literature [14] pointed out that rural carbon emissions, especially in recent years, showed a rapid upward trend, and pointed out that the increase in carbon emissions was mainly due to the increase in rural economic levels and the increase in energy consumption. Finally, it gave policy recommendations based on the current situation in rural areas, such as advocating low-carbon lifestyles, using clean energy, and transforming economic growth patterns. The literature [15] studied the current application of BIM in the field of green buildings, and pointed out the current problems in the application of BIM in green buildings and the future development trend. The literature [16] used BIM technology to conduct pre-planning and design of planning exhibition halls, and introduced the entire operation process of BIM in green buildings in detail. The literature [17] studied the coupling and interaction principle of green buildings and BIM technology to better realize the design of green buildings. Although the literature [18] proposed a BIM software-based construction carbon emission measurement model, it has not yet proposed the further use of it to assist carbon emission management decision-making.

3 DATA MINING ALGORITHM FOR RURAL GREEN BUILDINGS BASED ON BIG DATA TECHNOLOGY

The accuracy and generalization ability of a single decision tree is relatively limited, and it is very easy to overfit. Therefore, people put forward the concept of integrated learning, and the XGBoost

(ExtremeGradient Boosting) algorithm is a representative algorithm of integrated learning algorithms. This algorithm was proposed by Chen Tianqi (2014). Once proposed, it has been widely recognized by academia and industry for its top performance on most classification and regression problems. In recent years, the XGBoost algorithm has not only been used in various data mining competitions such as Kaggle and Tianchi, but also in the data analysis related work of major companies, XGBoost is also one of the most frequently appeared algorithms.

Based on the idea that all base classifiers of the Boosting algorithm are related, each time the tree is split, the XGBoost algorithm will generate a new tree in the direction of the last training residual reduction (negative gradient). After training, the sum of all tree scores is taken as the sample prediction value. The goal of the algorithm is to have a certain generalization ability while the error of the algorithm's predicted value is small. Therefore, from a mathematical point of view, this is a functional optimization problem.

First, we set the algorithm objective function as follows[19]:

$$L(x)=\sum_i L(\hat{y}_i, y)+\sum_k \Omega(f_k)+C \tag{1}$$

Among them,

$$\Omega(f)=\gamma T+\frac{1}{2}\lambda\|w\|^2 \tag{2}$$

In the above formula, $L(x)$ is the loss function, which can be derived or convex, and $\Omega(f)$ is the regular term function. Meanwhile, γ is the hyperparameter, and T is the total number of leaf nodes. $\lambda\|w\|^2$ is the regular term of L_2, and W is the weight of the leaf node. When the L_2 regular term is used to penalize the leaves with larger weights, the occurrence of over-fitting can be reduced, and C is a constant term.

Based on the Boosting idea, based on the above objective function, the XGBoost algorithm chooses to introduce a base classifier $f_t(x_i)$ for each split to optimize the loss function $L(x)$, so the objective function can be simplified as:

$$J(f_t)=\sum_{i=1}^{n} L\left(y_i, \hat{y}_i^{(t-1)}\right)+f_t(x_i)+\Omega(f_t)+C \tag{3}$$

Next, the objective function is subjected to a second-order Taylor expansion, and the formula is as follows:

$$f(x+\Delta x)\approx f(x)+f'(x)\Delta x+\frac{1}{2}f''(x)\Delta x^2 \tag{4}$$

The corresponding relationship between the objective function and the terms of the second-order Taylor expansion is as follows[20]:

The $f(x)$ in the Taylor second-order expansion corresponds to $L(x)$ in the objective function, the x in the Taylor second-order expansion corresponds to $\hat{y}_i^{(t-1)}$ in the objective function, and the Δx in the Taylor second-order expansion corresponds to $f_t(x_i)$ in the objective function.

Therefore, when $f(x)$ is derived from x in the original Taylor expansion formula, it corresponds to the objective function of the algorithm to obtain the partial derivative of $\hat{y}_i^{(t-1)}$.

When doing a second-order Taylor expansion of the objective function, we can get:

$$J(f_t) \approx \sum_{i=1}^{n} \left[L\left(y_i, \hat{y}_i^{(t-1)}\right) + g_i f_i(x_i) + \frac{1}{2} h_i f_i^2(x_i) \right] + \Omega(f_t) + C \tag{5}$$

Among them,

$$g_i = \frac{\partial L\left(y_i, \hat{y}_i^{(t-1)}\right)}{\partial \hat{y}_i^{(t-1)}} \tag{6}$$

$$h_i = \frac{\partial^2 L\left(y_i, \hat{y}_i^{(t-1)}\right)}{\partial \hat{y}_i^{(t-1)}} \tag{7}$$

The above functions g_i and h_i are the first derivative and the second derivative of the loss function, respectively.

Since the term $L\left(y_i, \hat{y}_i^{(t-1)}\right)$ is ultimately a constant, when the term is put into C, we can get:

$$J(f_t) = \sum_{i=1}^{n} \left[g_i f_t(x_i) + \frac{1}{2} h_i f_t^2(x_i) \right] + \Omega(f_t) + C \tag{8}$$

Since each base classifier $f_t(x_i)$ corresponds to a leaf node w_j, the objective function can be simplified to:

$$\begin{aligned} J(f_t) &= \sum_{j=1}^{T} \left[\left(\sum_{i \in I_j} g_i \right) w_j + \frac{1}{2} \left(\sum_{i \in I_j} h_i \right) w_j^2 \right] + \gamma \cdot T + \lambda \cdot \frac{1}{2} \sum_{j=1}^{T} w_j^2 + C \\ &= \sum_{i=1}^{T} \left[\sum_{i \in I_j} g_i w_j + \frac{1}{2} \left(\sum_{i \in I_j} h_i + \lambda \right) w_j^2 \right] + \gamma \cdot T + C \end{aligned} \tag{9}$$

By deriving w_j to be equal to 0, the optimal weight of the objective function can be obtained:

$$\frac{\partial J(f_t)}{\partial w_j} = \sum_{i \in I_j} g_i + \left(\sum_{i \in I_j} h_i + \lambda \right) w_j = 0 \Rightarrow w_j = -\frac{\sum_{i \in I_j} g_i}{\sum_{i \in I_j} h_i + \lambda} \tag{10}$$

By substituting w_j into the original objective function, we can get[21]:

$$J(f_t) = -\frac{1}{2} \sum_{j=1}^{T} \frac{\left(\sum_{i \in I_j} g_i \right)^2}{\sum_{i \in I_j} h_i + \lambda} + \gamma \cdot T \tag{11}$$

We can use the above objective function to evaluate the newly added base classifier f_t for each split, and use the greedy algorithm to find the optimal f_t, as follows:

Considering the simplest case of a single leaf, if we assume that the data set L is divided into L_1 and L_2 after splitting, we can calculate the score of $L_1 + L_2 - L$, which is the gain obtained by the system in this split. The algorithm will traverse all the segmentation methods of all features to find the segmentation method with the least loss, obtain two leaves, and then perform recursive traversal.

Among them, the objective function of a single leaf is as follows:

$$L_{split}=\frac{1}{2}\left[\frac{\left(\sum_{i\in L}g_i\right)^2}{\sum_{i\in L}h_i+\lambda}+\frac{\left(\sum_{i\in L_1}g_i\right)^2}{\sum_{i\in L_1}h_i+\lambda}-\frac{\left(\sum_{i\in L_2}g_i\right)^2}{\sum_{i\in L_2}h_i+\lambda}\right]-\gamma \tag{12}$$

If there are missing values in the training data, the XGBoost algorithm puts the missing values into L_1 and L_2 to calculate the score. Where the score is high, the missing value will be included in which side.

(1) The XGBoost algorithm is an integrated algorithm based on decision trees (usually CART decision trees), which can solve classification and regression problems with fast training speed and high accuracy.

(2) The XGBoost algorithm does a second-order Taylor expansion of the objective function, and uses the information of the first-order derivative and the second-order derivative of the objective function at the same time, which makes the convergence of the loss more accurate.

(3) XGBoost algorithm does pre-pruning while optimizing the objective function, which reduces the occurrence of over-fitting. Among them, the coefficient γ of T in the regular term can limit the threshold of tree growth. Only when the gain is greater than the threshold γ, the tree will be split. In addition, adding a regular term L_2 to the regular term can also play a role in reducing over-fitting.

(4) When the training data is sparse values, the XGBoost algorithm can choose the direction for the missing values, which greatly improves the efficiency of the algorithm.

(5) XGBoost can use parallel computing and distributed training, which improves the training speed of the algorithm. To create a random sample of 1 million data points with 20 features, it only takes 22s to call the XGBoost algorithm, which is about 100 times faster than the GBDT algorithm and about 20 times faster than the RF algorithm.

(6) The compatibility is very strong. The XGBoost algorithm can run on multiple platforms such as Windows, MacOS, Linux, and supports languages such as Python, R, C++, and Java[22].

4 MODERN DESIGN SYSTEM FOR RURAL GREEN BUILDINGS

Due to the different focus of the research, there are certain differences in the division of carbon emissions throughout the life cycle of buildings, and the carbon emissions of buildings are mainly concentrated in the materialization phase and the operation and maintenance phase. Based on the basic characteristics of rural residential green buildings in cold regions, this paper will focus on the construction phase of rural green buildings, including material production, processing, transportation, and mechanical power consumption during construction. At the same time, this paper studies the operation and maintenance phase of rural green houses, and conducts research on the demolition phase of buildings. Figure 1 shows the composition of carbon emissions during the full life cycle of rural green buildings in cold regions of my country

When using the principle of wind pressure for ventilation, attention should be paid to the seasonal dominant wind direction. Taking Shijiazhuang as an example, the southeast wind is the dominant wind direction in summer, and the northwest wind is the dominant wind direction in winter. In summer, the temperature and humidity are relatively high, so the coverage area of the building surface that can accept the dominant wind should be increased as much as possible to provide good indoor external conditions. In winter, considering the need for indoor heat preservation, the degree of influence of outside wind on the building interior should be reduced. In the residential design, the window area can be appropriately enlarged on the south side of the building, and the windward side of the dominant wind direction in summer can be enlarged, and the window opening faces the courtyard, which does not affect the privacy of the residence.

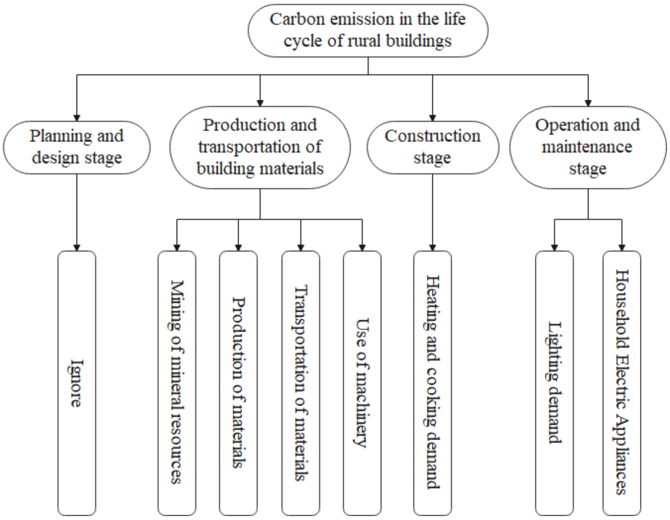

Figure 1: Carbon emissions during the full life cycle of rural buildings.

At the same time, high windows are installed on the north side of the building to reduce the windward side of the dominant wind direction in winter. According to the principle of rising of hot air, it is conducive to the discharge of hot air and can better protect the privacy of residential users (Figure 2).

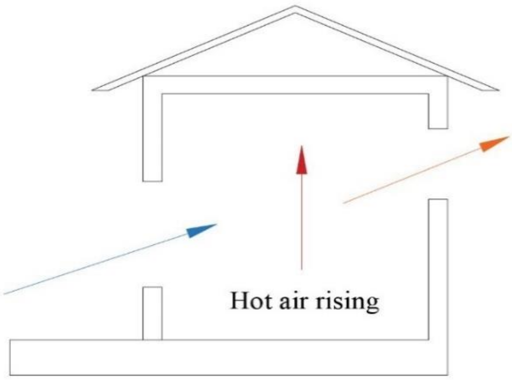

Figure 2: Horizontal flow diagram of indoor air.

The use of rainwater resources in the construction of new rural housing can effectively slow down the rate of groundwater level decline and reduce the occurrence of floods, which is of great significance for saving resources and improving the rural ecological environment. Rainwater will be mixed with suspended particles and impurities, and the use of rainwater needs to be filtered. Rainwater collection is divided into roof rainwater collection and ground rainwater collection. Ground rainwater collection is more difficult. Generally, planting and greening absorption is the main method. The roof rainwater collection system is divided into three aspects: rainwater collection device, rainwater filter device and rainwater storage device. The rainwater on the roof can be collected through the gutter, filtered through the rainwater bucket, and collected by the rainwater pipe into the reservoir. Reservoir is the most costly part of the rainwater collection system. It has the function of storing rainwater and precipitated particles. The capacity of the reservoir should be selected with full consideration of local rainfall characteristics in order to obtain the greatest economic benefits. The stored rainwater belongs to middle water, which can be used for washing, watering, evaporative cooling and many other aspects. The use of rainwater can be combined with the spray roof, and the roof is sprayed during the high temperature in summer, which has the effect of evaporating and cooling.

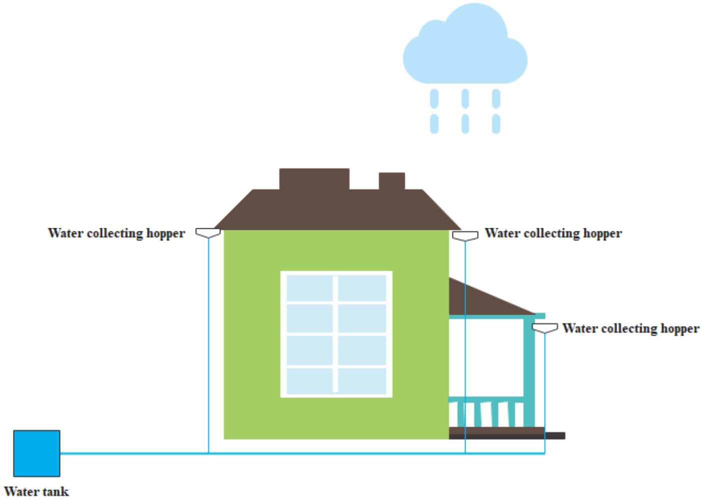

Figure 3: A schematic diagram of rainwater collection in rural houses.

The guidelines for the construction of green farm houses mentioned that in areas where water resources are scarce, rainwater collection and purification systems should be developed. Through analysis and research on drinking water in arid areas, it is found that most residents in arid areas use atmospheric precipitation for drinking. Rainwater is the main source of drinking water in the area, and rainwater is very important for local residents because groundwater and its reservoirs may dry up during dry periods. Moreover, rainwater can generally be collected and used by a single household or by a village as a unit, such as traditional water cellars and fishing ponds around the village. The lower terrain is the main collection point for rainwater. In arid areas, people use roof gutters to collect rainwater, and another way to collect rainwater is to build water cellars. In order to ensure the quality of drinking water, people will install filtering devices at the entrance of the water cellar to reduce the entry of large particles into the water cellar, and use concrete to build it to ensure safety. Figure 4 shows the steps of collecting rainwater in rural areas and the comprehensive utilization process.

In the construction of the farm house, we chose to set up the biogas digester below the livestock pen near the bathroom, which is not only convenient for adding raw materials to the biogas digester, but also the manure and grass nest of the livestock in the livestock pen can ensure the temperature of the biogas digester in winter to make it ferment normally. At the same time, we can take advantage of the superior solar energy conditions in this area to cover the livestock pen with a plastic film to form a simple solar house, which not only promotes the health of the livestock but also guarantees the fermentation temperature of the biogas digester.

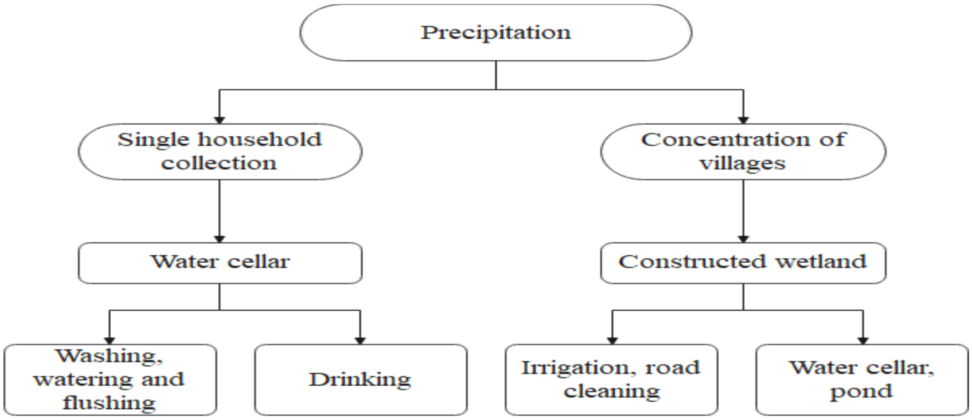

Figure 4: Rainwater collection steps and comprehensive utilization process in rural areas.

The national "User Biogas Digester Standard Atlas" stipulates that the construction of biogas digesters must achieve "three combinations", that is, the construction of biogas digesters must be combined with pens and toilets. Moreover, the complex should be built at a place leeward to the sun, and it should face south from the north, and there is no building block around it, and it should extend in the east-west direction. The details are shown in Figure 5.

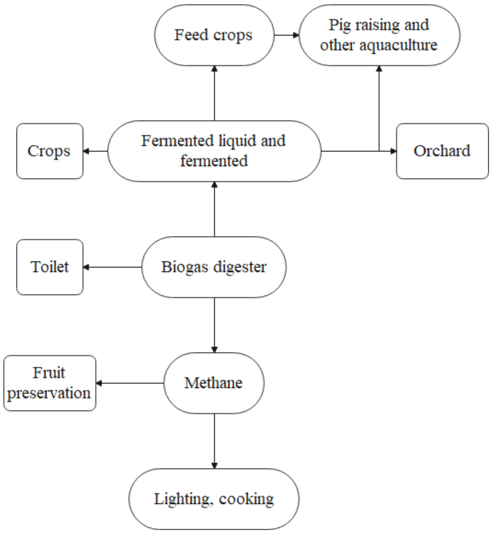

Figure 5: Comprehensive utilization of biogas model.

The biogas digester is designed in the southwest corner of the courtyard adjacent to the indoor toilet of the kiln farm house and the kiln courtyard toilet and adjacent to the pig pen, which is conducive to making full use of raw materials. Since it is not possible to add toilets in the independent cave dwellings as in the house courtyards, the original dry toilets in the cave dwellings courtyards need to be retained. Here, we briefly introduce the design of the aqua toilet. The design of the aqua toilet should include walls, doors, and windows, and the height of the wall should be greater than 2 meters, and the area should be greater than 2 square meters. At the same time, the septic tank must be closed to achieve a comfortable living environment, and the airtight performance needs to be good, and it is necessary to ensure that the treatment of feces is harmless. In the interior of the toilet, complete cleaning facilities need to be added to ensure that the toilet is clean and hygienic, and the lighting effect must meet the requirements. According to the construction standards of green farm houses, the three- grille fecal treatment mode applied and promoted is shown in Figure 6. At the same time, in response to energy conservation and environmental protection, septic tanks can be transformed into biogas tanks. In particular, for water-scarce areas, this model of energy-saving, ecological and environmentally-friendly toilets should be promoted.

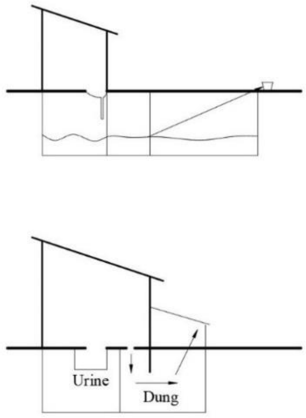

Figure 6: The model of three-grille sanitary dry toilets in rural houses and dry toilets with feces and urine separated.

In the use of passive solar energy, we should skillfully handle the external shape and internal space of the building, and set the living room and bedroom to the south to strive for maximum heat gain in winter. For rooms that are mainly used during the day, such as the living room, an additional sun room type sun room should be used. However, for rooms that are mainly used at night, the direct benefit type with complete thermal insulation facilities and the heat collection and storage wall type with greater heat storage capacity can be selected. In Figure 7, three common forms of passive solar houses are listed.

5 RESEARCH ON THE EFFECT OF MODERN DESIGN OF RURAL GREEN BUILDINGS BASED ON BIG DATA TECHNOLOGY

This paper combines the concept of modernization of rural green buildings to construct a data mining system for rural green building design. The data mining system of this paper mainly conducts mining and analysis of multiple influencing factors that constitute the design requirements of rural green buildings. Therefore, when this paper conducts system performance verification test analysis, we first verify the data mining effect of the data mining algorithm constructed in this paper in the modern design of rural green buildings. On this basis, this paper verifies the effect of the green building design method proposed in this paper. First, this paper analyzes the data mining effect of the improved data mining algorithm in the modern design of rural green buildings. The statistical results are shown in Table 1 and Figure 8.

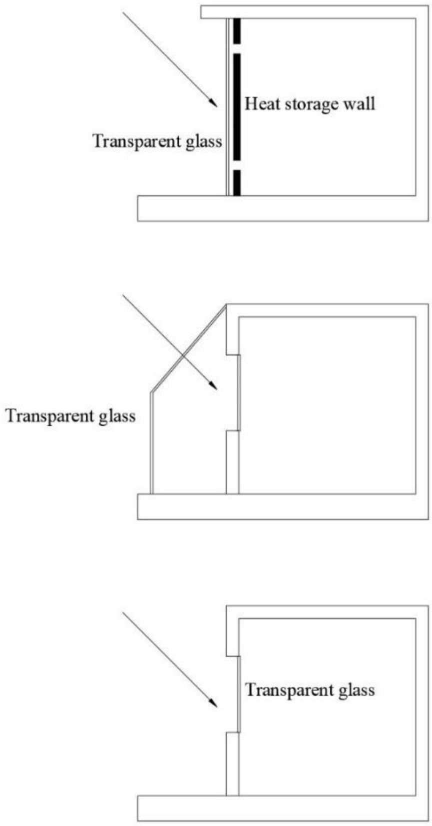

Figure 7: Three basic forms of passive solar houses.

Num	*Building data analysis*	*Num*	*Building data analysis*	*Num*	*Building data analysis*
1	*86.9*	*29*	*91.5*	*57*	*90.0*
2	*79.4*	*30*	*80.7*	*58*	*92.4*
3	*93.7*	*31*	*80.3*	*59*	*88.0*
4	*84.9*	*32*	*92.2*	*60*	*83.6*
5	*84.6*	*33*	*80.3*	*61*	*81.2*
6	*85.9*	*34*	*79.3*	*62*	*90.1*
7	*82.4*	*35*	*88.5*	*63*	*80.2*
8	*82.1*	*36*	*88.0*	*64*	*81.7*
9	*92.1*	*37*	*88.5*	*65*	*81.1*
10	*87.7*	*38*	*93.5*	*66*	*80.4*
11	*92.4*	*39*	*93.0*	*67*	*91.7*
12	*89.7*	*40*	*90.2*	*68*	*79.8*

13	*82.6*	*41*	*88.1*	*69*	*84.9*
14	*90.3*	*42*	*81.6*	*70*	*81.6*
15	*87.7*	*43*	*82.9*	*71*	*86.5*
16	*89.4*	*44*	*84.1*	*72*	*92.6*
17	*79.9*	*45*	*86.8*	*73*	*88.3*
18	*92.2*	*46*	*80.5*	*74*	*91.0*
19	*84.1*	*47*	*82.7*	*75*	*92.6*
20	*80.6*	*48*	*84.3*	*76*	*81.5*
21	*80.3*	*49*	*85.6*	*77*	*86.4*
22	*85.9*	*50*	*92.4*	*78*	*86.9*
23	*80.2*	*51*	*89.2*	*79*	*90.5*
24	*92.5*	*52*	*90.7*	*80*	*81.7*
25	*88.3*	*53*	*89.4*	*81*	*87.8*
26	*91.7*	*54*	*79.2*	*82*	*93.9*
27	*88.3*	*55*	*93.7*	*83*	*80.1*
28	*79.0*	*56*	*90.7*	*84*	*87.6*

Table 1: Statistical table of the data mining effect of the improved data mining algorithm in the modern design of rural green buildings.

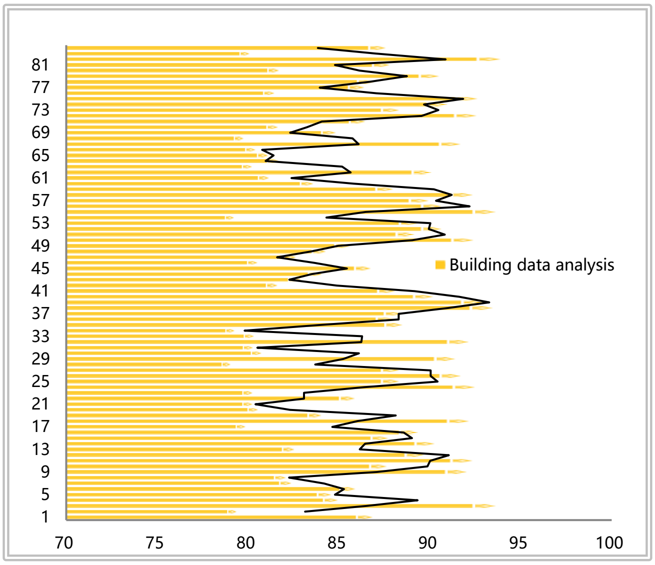

Figure 8: Statistical diagram of the data mining effect of the improved data mining algorithm in the modern design of rural green buildings.

From the above analysis, we can see that the improved data mining algorithm in this paper can play a good data mining effect in the modern design of rural green buildings. On this basis, this paper analyzes the modern design effect of green buildings, and the results are shown in Table 2 and Figure 9.

Num	*Architectural design*	*Num*	*Architectural design*	*Num*	*Architectural design*
1	*80.3*	*29*	*72.0*	*57*	*74.7*
2	*80.7*	*30*	*74.1*	*58*	*76.7*
3	*71.3*	*31*	*75.8*	*59*	*76.9*
4	*74.7*	*32*	*77.7*	*60*	*81.2*
5	*76.2*	*33*	*81.0*	*61*	*73.2*
6	*79.6*	*34*	*78.2*	*62*	*78.0*
7	*78.7*	*35*	*74.3*	*63*	*74.1*
8	*78.3*	*36*	*78.9*	*64*	*73.3*
9	*81.6*	*37*	*78.2*	*65*	*73.6*
10	*81.5*	*38*	*76.8*	*66*	*76.0*
11	*73.5*	*39*	*76.8*	*67*	*74.4*
12	*80.7*	*40*	*76.4*	*68*	*76.5*
13	*74.9*	*41*	*76.4*	*69*	*73.1*
14	*78.6*	*42*	*78.7*	*70*	*75.5*
15	*73.1*	*43*	*75.8*	*71*	*78.3*
16	*78.1*	*44*	*71.7*	*72*	*71.6*
17	*75.2*	*45*	*74.8*	*73*	*77.6*
18	*72.8*	*46*	*71.1*	*74*	*76.7*
19	*74.3*	*47*	*73.1*	*75*	*74.5*
20	*72.7*	*48*	*71.0*	*76*	*80.2*
21	*80.5*	*49*	*80.0*	*77*	*76.1*
22	*73.5*	*50*	*79.9*	*78*	*75.1*
23	*72.8*	*51*	*71.0*	*79*	*76.6*
24	*77.5*	*52*	*73.2*	*80*	*72.7*
25	*77.1*	*53*	*76.7*	*81*	*74.1*
26	*80.1*	*54*	*80.3*	*82*	*78.1*
27	*78.0*	*55*	*77.0*	*83*	*73.3*
28	*72.9*	*56*	*71.9*	*84*	*72.8*

Table 2: Statistical table of the design effect of the green building modern design system based on big data technology constructed in this paper.

Through the above analysis, we can see that the green building modern design system based on big data technology constructed in this paper can effectively improve the design effect of rural green buildings.

6 CONCLUSION

The construction of a new countryside is an objective requirement of the country's modernization and development, and it is also a project that benefits farmers' livelihoods. In order to alleviate the energy crisis, the concept of green building was proposed in the last century, and was later promoted by a large area, and it has also been greatly promoted in our country.

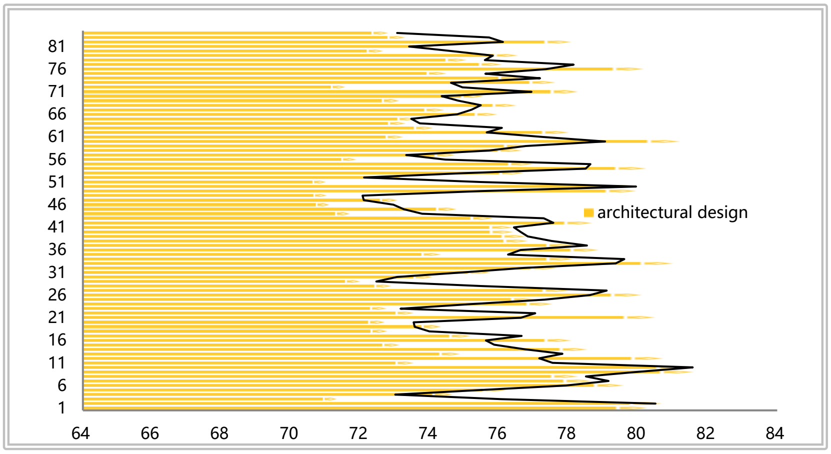

Figure 9: Statistical diagram of the design effect of the green building modern design system based on big data technology constructed in this paper.

At present, it is necessary to use quantitative analysis methods to further analyze the driving factors of new rural green buildings. In the operation stage of rural green buildings, data mining technology uses energy consumption software to simulate and analyze the energy consumption of the building. Moreover, it can calculate the energy consumption in the normal operation phase, calculate the corresponding energy consumption, and multiply it by the carbon emission factor of the corresponding energy to derive the carbon emissions during the operation phase. This paper uses big data technology to conduct data mining of rural green building modernization, constructs the corresponding system structure, and analyzes the rural green modern design to improve the modern design effect of rural green buildings. Finally, this paper combines experimental research to prove the effectiveness of this method.

Zhanguo Hao, https://orcid.org/0009-0006-8312-6064
BuYin Ao qi er, https://orcid.org/0009-0002-4533-7443

ACKNOWLEDGEMENT

Study on the wide-area light distribution characteristics and influencing factors of grassland night sky (51908298)

REFERENCES

[1] Abuimara, T.; O'Brien, W.; Gunay, B.: et al. Towards occupant-centric simulation-aided building design: a case study, Building Research & Information, 2019, 47(8): 866-882. https://doi.org/10.1080/09613218.2019.1652550

[2] Adilkhodjayev, A. I.; Mahamataliev, I. M.; Shaumarov, S. S.: Theoretical aspects of structural and simulation modeling of the macrostructure of composite building materials, Journal of Tashkent Institute of Railway Engineers, 14(2), 2019, 3-14. https://doi.org/10.22281/2413-9920-2018-04-03-312-320

[3] Andrio, P.; Hospital, A.; Conejero, J.: et al. BioExcel Building Blocks, a software library for interoperable biomolecular simulation workflows, Scientific Data, 6(1), 2019, 1-8. https://doi.org/10.1038/s41597-019-0177-4

[4] Beausoleil-Morrison, I.: Learning the fundamentals of building performance simulation through an experiential teaching approach, Journal of Building Performance Simulation, 12(3), 2019, 308-325. https://doi.org/10.1080/19401493.2018.1479773

[5] Black, A. D.: Wor (l) d-Building: Simulation and Metaphor at the Mars Desert Research Station, Journal of Linguistic Anthropology, 28(2), 2018, 137-155. https://doi.org/10.1111/jola.12183

[6] Brunelli, A.; de Silva, F.; Piro, A.: et al. Numerical simulation of the seismic response and soil–structure interaction for a monitored masonry school building damaged by the 2016 Central Italy earthquake, Bulletin of Earthquake Engineering, 19(2), 2021, 1181-1211. https://doi.org/10.1007/s10518-020-00980-3

[7] Chakraborty, D; Elzarka, H.: Advanced machine learning techniques for building performance simulation: a comparative analysis, Journal of Building Performance Simulation, 12(2), 2019, 193-207. https://doi.org/10.1080/19401493.2018.1498538

[8] Dodd, T.; Yan, C.: Ivanov, I.: Simulation-Based Methods for Model Building and Refinement in Cryoelectron Microscopy, Journal of chemical information and modeling, 60(5), 2020, 2470-2483. https://doi.org/10.1021/acs.jcim.0c00087

[9] Endo, N.; Shimoda, E.; Goshome, K.; et al.: Simulation of design and operation of hydrogen energy utilization system for a zero emission building, International Journal of Hydrogen Energy, 44(14), 2019, 7118-7124. https://doi.org/10.1016/j.ijhydene.2019.01.232

[10] Feng, X.; Yan, D.; Wang, C.: On the simulation repetition and temporal discretization of stochastic occupant behaviour models in building performance simulation, Journal of Building Performance Simulation, 10(5-6), 2017, 612-624. https://doi.org/10.1080/19401493.2016.1236838

[11] Guerra-Santin, O.; Silvester, S.: Development of Dutch occupancy and heating profiles for building simulation, Building Research & Information, 45(4), 2017, 396-413. https://doi.org/10.1080/09613218.2016.1160563

[12] Hanson, K.; Hernandez, L.; Banaski Jr, J. A.: Building simulation exercise capacity in Latin America to manage public health emergencies, Health Security, 16(S1), 2018, S-98-S-102. https://doi.org/10.1089/hs.2018.0091

[13] Imam, S. Coley, D. A.; Walker, I.: The building performance gap: Are modellers literate?, Building Services Engineering Research and Technology, 38(3), 2017, 351-375. https://doi.org/10.1177/0143624416684641

[14] Lee, C. W.; Cho, S. J.: The development of converting program from sealed geological model to Gmsh, COMSOL for building simulation grid, Journal of the Korean earth science society, 2017, 38(1): 80-90. https://doi.org/10.5467/JKESS.2017.38.1.80

[15] Miller, C.; Thomas, D.; Kämpf, J.: et al. Urban and building multiscale co-simulation: case study implementations on two university campuses, Journal of Building Performance Simulation, 2018, 11(3): 309-321. https://doi.org/10.1080/19401493.2017.1354070

[16] Mou, B.; He, B. J.; Zhao, D. X.: et al. Numerical simulation of the effects of building dimensional variation on wind pressure distribution, Engineering Applications of Computational Fluid Mechanics, 2017, 11(1): 293-309. https://doi.org/10.1080/19942060.2017.1281845

[17] Pei, J. S.; Carboni, B.; Lacarbonara, W.: Mem-models as building blocks for simulation and identification of hysteretic systems, Nonlinear Dynamics, 100(2), 2020, 973-998. https://doi.org/10.1007/s11071-020-05542-5

[18] Petrou, G.; Mavrogianni, A.; Symonds, P.: et al. Can the choice of building performance simulation tool significantly alter the level of predicted indoor overheating risk in London flats?, Building Services Engineering Research and Technology, 40(1), 2019, 30-46. https://doi.org/10.1177/0143624418792340

[19] Remmen, P.; Lauster, M.; Mans, M.: et al. TEASER: an open tool for urban energy modelling of building stocks, Journal of Building Performance Simulation, 11(1), 2018, 84-98. https://doi.org/10.1080/19401493.2017.1283539
[20] Wati, E. K.; Widiansyah, N.: Design of learning media: Modeling & simulation of building thermal comfort optimization system in building physics course, Jurnal Pendidikan IPA Indonesia, 9(2), 2020, 257-266. https://doi.org/10.15294/jpii.v9i2.23504
[21] Xie, X. Gou, Z.: Building performance simulation as an early intervention or late verification in architectural design: Same performance outcome but different design solutions, Journal of Green Building, 12(1), 2017, 45-61. https://doi.org/10.3992/1552-6100.12.1.45
[22] Xiong, C.; Huang, J.; Lu, X.: Framework for city-scale building seismic resilience simulation and repair scheduling with labor constraints driven by time–history analysis, Computer-Aided Civil and Infrastructure Engineering, 35(4), 2020, 322-341. https://doi.org/10.1111/mice.12496