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Computer-Aided Design AND APPLICATIONS

Using CAD and Multi-Modal Integration to Realize Intelligent Pavilion Design Optimization

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Abstract. With the development of society and the progress of science and technology, the construction of venues as public places has attracted more and more researchers' attention. The optimization of the intelligent pavilion platform and the interior design of the pavilion should not only pay attention to the special needs of the masses but also be combined with the overall layout to achieve safer, energy-saving and intelligent operation and management. In this paper, with the help of CAD computer-aided and multi-modal fusion technology, the optimization process of smart Intelligent pavilion design is studied. Firstly, the main problems and existing challenges in the design and construction of smart intelligent pavilions are extracted by using literature data analysis. The interior space layout model of the Intelligent pavilion is generated in the intelligent software by using CAD computer-aided function, and the path planning based on a humanized tour is constructed by combining the indoor positioning method. Finally, multi-modal fusion technology is used to complete the design and display of the smart intelligent pavilion. The three-dimensional retrieval function of the multi-modal fusion model was used to describe the design features of the smart intelligent pavilion and extract information about people's needs to complete the training. Then the three-dimensional model is built to realize the interaction with the masses in the virtual space and improve the interaction of the smart pavilion. The research results show that the intelligent pavilion design optimization scheme realized by CAD and multi-modal fusion technology integrates intelligent resources to improve the quality and efficiency of pavilion construction and can also meet the diversified and personalized needs of the masses.

Keywords: CAD Technology; Multimodal Fusion; Intelligent pavilion; Design Optimization; Three-Dimensional Retrieval
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1 INTRODUCTION

The traditional construction mode of intelligent pavilions is difficult to adapt to the increasingly complex design needs and the extremely short construction time requirements, and there are also problems of poor information in the internal spatial planning and platform management of intelligent pavilions [1]. The distribution of tasks and processes inside the pavilion makes the design layout more difficult, which not only affects the construction schedule but also leads to the waste of resources. Therefore, the construction of intelligent pavilions urgently needs innovative intelligent transformation and quality improvement in design optimization and construction. The construction of an Intelligent pavilion especially has good performance in data analysis and spatial layout decision-making. Through intelligent algorithms and computer-aided tools, designers can be provided with a large amount of reliable data support to ensure the efficient implementation of the project. According to the research results, it is now popular to use the Internet of Things, and computer intelligence as the support of the new digitization, intelligence, and information museum management model. The smart intelligent pavilion is also highly integrated with the Internet, which provides the intelligent pavilion management platform with opportunities for online and offline real-time interaction, and also enables the efficient use of intelligent pavilion resources, and saves a lot of exhibition time and construction costs. In addition, it breaks the limitations of time and space of the intelligent pavilion and provides the organizers and visitors with a full range of responsive services [2].

The design of Intelligent pavilions needs to consider the changes in exhibition themes, layouts, and visitor groups. Therefore, improving the cross-scenario and user generalization performance of HAR systems is crucial. In smart intelligent pavilions, non-contact interaction technology can enhance the comfort and engagement of visitors. When exploring strategies to enhance employee happiness in intelligent office environments, the Human Activity Recognition (HAR) system is not limited to traditional office spaces. Its potential can also be extended to more complex and interactive environments, such as smart Intelligent pavilion design [4]. Simultaneously utilizing multimodal sensor technology to achieve precise user behaviour analysis, in order to optimize content presentation, navigation services, and personalized interaction. For example, when using infrared array sensors for non-contact monitoring, blurring processing can be used to reduce the ability to identify personal identity while ensuring the accuracy of behavioural data. Due to the large number of people involved in intelligent pavilions and the diverse behaviour of visitors, encryption technology, anonymization processing, and user-controllable data collection mechanisms need to be integrated into the design to ensure the privacy and security of visitors [3]. This not only helps intelligent pavilion managers to accurately analyze visitor behaviour patterns, but also provides visitors with more personalized tour routes, interactive experiences, and content recommendations. In the smart intelligent pavilion, the application of the HAR system must strictly comply with privacy protection principles. Through the residual 3D CNN and 1D CNN deep learning models mentioned in this study, it is possible to effectively integrate these multimodal data and achieve deep mining and understanding of spatiotemporal features [4]. As a cutting-edge platform for showcasing innovation, education, and entertainment, the design of smart intelligent pavilions requires a high level of attention to visitors' experiences and privacy protection. Based on the specific needs of smart intelligent pavilions, the application of multimodal sensors (such as infrared arrays, pressure distribution sensing floors, VR/AR devices, and sensors built into smartphones) can comprehensively capture the behaviour, interests, and emotional states of visitors. Through an adaptive decision fusion strategy, the system can dynamically adjust the weight of data fusion, adapt to the differences in behavioural characteristics in different scenarios, and ensure that no matter how the intelligent pavilion changes, it can provide stable and efficient services for visitors [5].

In the complex field of intelligent exhibition design, the importance of quality and time efficiency as core performance indicators is self-evident. Considering that smart intelligent pavilions integrate high-tech display methods and immersive experiences, traditional 2D and 3D design representations can provide some visual preview. However, it is often difficult to convey the final effect comprehensively and intuitively, especially when it comes to digital elements such as multimedia, lighting, sound effects, and complex interactions. Especially during the installation and construction phase, any changes caused by poor design performance may result in expensive rework, which not only increases project costs but may also delay the opening plan of the intelligent pavilion [6]. To address this design communication bottleneck, some scholars have innovatively proposed an Intelligent pavilion design model that combines virtual reality (VR) technology. By adopting qualitative research methods, five experts with rich experience in the field of Intelligent pavilion design were specially invited to participate in the case study, and the VR model was thoroughly tested and evaluated. This model aims to significantly improve communication and decision-making efficiency during the design phase by creating a highly realistic virtual environment that allows non-AEC decision-makers and all stakeholders to experience and evaluate design solutions in person. It can not only capture potential design issues in the early stages and reduce the need for later changes [7]. It also allows stakeholders to intuitively feel and participate in the design process, ensuring that the design scheme can better meet the needs and expectations of all parties. The research results show that VR technology significantly enhances the communication and collaboration abilities among designers, engineers, curators, and end-users. More importantly, VR technology provides an unprecedented display platform for multimedia, lighting, sound effects, and other digital elements in the design of Intelligent pavilions. These elements are perfectly integrated with the virtual environment, creating an unprecedented immersive experience for visitors. Through VR models, the design team can more accurately adjust and optimize these elements, ensuring that they can also present stunning effects in real environments [8].

At present, the distribution of China's smart pavilions is uneven, and it has been a healthy and stable development in eastern cities. The domestic first-line and second-line urbanization process is fast, and the field of intelligent pavilions has also broken through the traditional business model. The number and area of smart pavilions have steadily increased, forming a new market competition pattern. Considering that most venues in China are mainly operated by leasing and generally do not have the role of hosting, the design of smart pavilions needs to focus on spatial layout and platform services. As much as possible to achieve digital exhibition, and can support rapid on-site decision-making, to ensure the personalized and diversified needs of customers, and improve the experience of every visitor. At the same time, the smart pavilion provides differentiated and customized access services, which can also attract customers to enhance market competitiveness [9]. In the construction and layout of the pavilion, it is necessary to meet the concept of sustainable green architecture and development. The application of computer intelligence technology in the design stage can optimize the spatial pattern, and reduce the waste of resources at the spatial level and the impact on the external environment. At present, the research results on the space and display of smart intelligent pavilions in China have been representative to a certain extent. As for the analysis norms of space design, the standards require an immersive exhibition layout and the investigation of the emotional and spiritual needs of the masses. Starting from the Intelligent pavilion design optimization, this paper uses CAD computer-aided and multi-modal fusion technology to study the optimization path. Combined with the data analysis results of the design cases of smart intelligent pavilions at home and abroad, the paper innovatively generates a three-dimensional immersive interactive space, providing a customized entry plan for the smart intelligent pavilion to meet the needs of the masses.

2 DEVELOPMENT AND APPLICATION OF CAD AND MULTIMODAL FUSION TECHNOLOGY

CAD technology, as the foundation of computer-aided manufacturing, has the advantages of being intuitive, efficient, accurate, convenient, and in line with complex design thinking. It has been widely applied in many fields, such as machinery, electronics, and automobiles, triggering the combination of product design and intelligent means. Guo [10] has become a core competitive technology by shortening the product design cycle and improving the quality of design solutions. With the help of computer systems, CAD computer-aided technology has completed the requirements of three-dimensional transformation on a two-dimensional plane, and relevant parameters can be adjusted at any time in the software to optimize the design scheme. With the support of policies, many countries have used CAD software to complete the system development of 3D geometric modelling engines, promoting the high-quality development of the industrial design industry. In the field of design and manufacturing, American researchers pay more attention to the parametric modelling of CAD technology. Parameterized modelling and several data representation rule features can be dynamically adjusted, and using these data can quickly modify the model. In the application process, it is usually necessary to establish sequence dependency relationships and sequences based on feature information, so it has good applicability in modifying data and completing global reliability modelling. Moayedi and Mosavi [11] applied CAD technology to the construction of virtual scenes. They automatically generate two-dimensional spatial design drawings in computer software and use CAD models to generate corresponding three-dimensional images. Create an immersive interactive platform in a 3D scene by adjusting parameters that meet the needs of the general public.

In the Intelligent pavilion, the DT layer is responsible for building highly realistic virtual intelligent pavilion models. Pistofidis et al. [12] used monitoring data to enable the system to monitor the status of intelligent pavilions in real time, providing a foundation for subsequent decision support. The tour guide system combines virtual reality (VR) and augmented reality (AR) technologies to provide personalized travel services for tourists and enhance their viewing experience. These sensors include but are not limited to temperature, humidity, lighting, sound, image recognition (such as facial recognition, and behaviour analysis), etc., providing rich data sources for the system. The control layer is responsible for the precise control of various facilities in the intelligent pavilion based on the data collected by the perception layer and the simulation results of the DT layer. The air conditioning and ventilation system adjusts the indoor environment based on temperature and humidity data to ensure the comfort of tourists. Management is the "brain" of Intelligent pavilions, integrating key functions such as Product Lifecycle Management (PLM), ticketing systems, and navigation systems. Through the PLM system, the lifecycle of exhibits can be effectively managed, including storage, display, and removal processes. The ticketing system provides convenient ticketing services and visitor management. In addition, the control layer also involves the management of security monitoring systems, such as video surveillance, access control systems, etc., to ensure the safe operation of the intelligent pavilion. Based on visitor behaviour data and feedback, dynamically adjust the exhibition layout, exhibition displays, and interactive activities to better meet the needs and expectations of visitors. For example, the intelligent lighting system can automatically adjust the brightness and colour temperature of the lights based on the brightness and location of visitors in the intelligent pavilion. Sun et al. [13] collected various data in the intelligent pavilion in real-time through high-precision sensors and IoT technology. Factors such as temperature and humidity, light intensity, and crowd density drive the dynamic updating of virtual models. This model not only includes the geometric and physical characteristics of the exhibits, but also simulates the multidimensional information of the environment, lighting, sound effects, and pedestrian flow dynamics in the intelligent pavilion.

Unlike CAD technology, multimodal fusion technology is the process of fusing various data and feature information with the support of deep learning. Although the powerful training ability of deep learning has achieved excellent results in the single-mode field, it is difficult to fully express all the information about a phenomenon. Therefore, in order to overcome the barriers of single-mode feature representation, Sun et al. [14] used multi-mode fusion to extract information values, which can improve the learning performance of the training model. Multimodal fusion technology can also provide relevant features between various modes such as text, images, videos, and speech for computers and machines. Developed countries started early in the development and application of multimodal fusion technology. Zhang et al. [15] found that complex information about human life includes a large amount of auditory, visual, tactile, olfactory, and so on. This interactive environment is faced with a large amount of diverse data, which can be integrated and applied in multidimensional space to achieve more intelligent application requirements. For example, British researchers have applied multimodal fusion technology to the field of autonomous driving. During autonomous driving, auxiliary software can obtain real-time road conditions, and LiDAR can also detect the distance between the vehicle and other objects. Sound sensors are used to determine the listening position and compensate for visual blind spots and poor road information. These multimodal data provide reliable information assistance for autonomous driving. CAD technology performs well in the spatial layout optimization design of intelligent pavilions, and multimodal fusion technology can combine various data sets to provide assistance for intelligent services in intelligent pavilions.

3 CAD AND MULTI-MODAL INTEGRATION TECHNOLOGY TO REALIZE INTELLIGENT PAVILION DESIGN OPTIMIZATION

3.1 CAD Computer-Aided Intelligent Pavilion Design Scheme Generation

With the development of science and technology, the Internet and computer technology, as the main force of modern science and technology, have brought a huge impact on all sectors of society. To seek a better development direction, more and more enterprises actively introduce computer-aided high-end skills to promote the construction of new industrial forms. At present, the design of the most intelligent pavilions in China is still mainly static, and the internal layout is limited to the needs of different functions. The relevant exhibition information also needs regular maintenance and update and introduction by professionals, which leads to high construction and maintenance costs of the intelligent pavilion, and ultimately affects the visit experience of the visitors. At the same time, the way of text introduction in the ordinary intelligent pavilion is mainly based on an information review, and the visitors will not only feel bored in the museum but also can not bring the tour interest. To this end, some large intelligent pavilions set up fixed intelligent pavilions for tourists to play relevant content videos, and use dynamic and static collocation from the spatial layout to meet the diversified personality needs of the masses.

When intelligent life is deeply rooted in people's hearts, computer-aided equipment has good applicability in the optimization of Intelligent pavilion design. This paper uses CAD technology to help realize the interior space design of an Intelligent pavilion. CAD computer-aided modelling is a process of reassembling three-dimensional spatial sampling. Common two-dimensional plane plans are constructed in three-dimensional space, and relevant information of spatial layout optimization is added to improve the ability of using model parameters. Depth cameras are arranged in the field, and data acquisition devices such as laser scanning and the Internet are used to remove noise from the acquired real data and add it to CAD software to complete the scene simulation. First of all, we analyzed the full operational modules of the smart pavilion design, as shown in Figure 1.

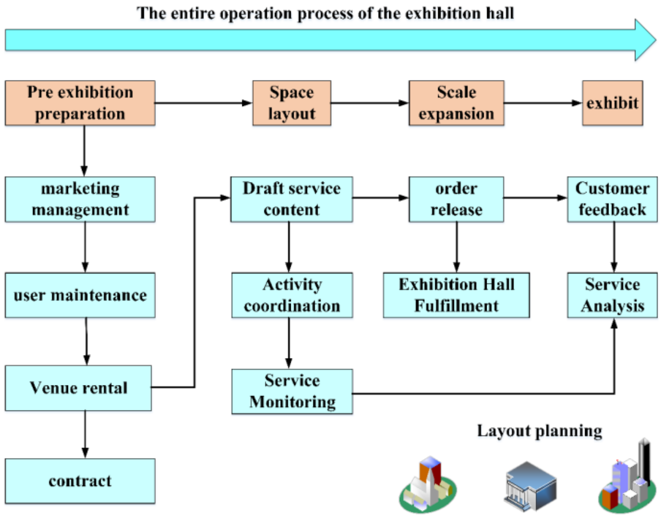

Figure 1: The full operational module of the smart Intelligent pavilion design.

As can be seen from Figure 1, the intelligent pavilion design starts with the planning and layout to complete the pre-exhibition preparation and space layout of the intelligent pavilion. The Marketing Department needs to design corresponding customer maintenance methods and complete site leasing and contract signing according to the intelligent pavilion service objectives. In the subsequent tour of the intelligent pavilion, complete the feedback and evaluation of each user. To optimize the space of the smart intelligent pavilion, discrete data is used to remove relevant outliers in the process of point-based 3D modelling reconstruction. To ensure the quality of 3D modelling. With the rapid increase in the use of data scales, the uniform distribution of samples and details has a great impact on 3D space design. In this regard, we also need to improve the efficiency of CAD modelling while ensuring the quality of modelling. The space shaping of the intelligent pavilion is not fully compatible with the theme of wisdom, nor can it complete an independent display by itself; it is just an exhibition container of artistic thinking. The space of the Intelligent pavilion is not a simple square box but needs to provide the possibility of experience from the user's needs and the multi-angle and multi-directional aspects of the exhibition planning. To verify the effectiveness of CAD 3D modelling technology for spatial layout optimization, we compared the changes in the number of noise points in 3D smart, intelligent pavilion model images before and after CAD modelling.

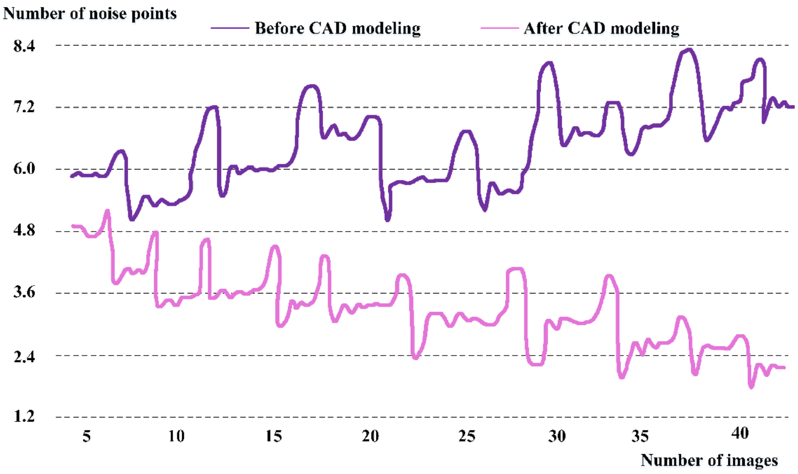

Figure 2: Changes in the number of noise points in the 3D smart, intelligent pavilion model images before and after using CAD modelling.

As can be seen from Figure 2, from the changes in the number of noise points in the image, there is less interference noise in the 3D model after CAD modelling, and the subsequent scene is more refined. In terms of exhibition mode, we start from the psychological needs of the audience. Most people's requirements for intelligent pavilions are to get spatial interaction without touching the exhibits. This kind of immersive experience demands great challenges for the intelligent interior experience mode of the intelligent pavilion. Subsequently, we use multi-modal fusion technology to complete the fusion of different spatial information and improve the interaction of the intelligent pavilion.

3.2 Multi-Modal Fusion Technology of Intelligent Pavilion Design Three-Dimensional Display

The Smart intelligent pavilion is based on digitalization and uses new technologies such as the Internet, computers, and big data to build a comprehensive, transparent, and perceptive intelligent pavilion form. Its purpose is to manage the intelligent pavilion efficiently with the help of intelligence. Under the premise of ensuring the safety of the exhibits, the masses can experience intelligent and digital services during the tour. The traditional intelligent pavilion has a lot of written materials, and the manual management method is low in efficiency and difficult to manage. In the face of some intelligent pavilions with high professional demands, most visitors do not have professional knowledge, and they cannot understand the information to be conveyed by the intelligent pavilion without an interpreter. In addition, the spatial layout and service experience also have a greater impact on the activities of the public.

According to the demand analysis, most visitors are concerned about the positioning, navigation, information push, and introduction of products in the intelligent pavilion. Regarding the information push introduction section, the social intelligent pavilion needs to provide detailed information on product content intelligently, complete geographical location identification while ensuring the characteristics of the intelligent pavilion, and provide corresponding services based on the different attributes and scale of exhibitors. In the location service function module, visitors can also automatically search for the location of exhibits based on the current layout and choose to experience the exhibition content they are interested in. Therefore, in the design process of Intelligent pavilions, it is also necessary to provide intelligent route navigation and point-of-interest positioning. In the information management module, exhibitors need to summarize the product information content of the entire intelligent pavilion, including the development of relevant graphic introductions and voice and video materials. Add corresponding numbers when pushing detailed information to visitors to complete virtual interaction between visitors and exhibits.

With the progress of science and technology and computer intelligence technology in recent years, China's use of multi-modal fusion technology to complete the corresponding products of pavilion design optimization has gradually caught up. Based on the results of the literature survey, we collect statistics on the development of smart pavilions in recent years from big data:

Time	*Intelligent pavilion Title*	*Attribute*
2024.7	Haier Smart Building Intelligent Pavilion	Science And Technology
2024.3	Wave Smart Medical Intelligent Pavilion	Medical Category
2024.1	Fantuo Smart Intelligent Pavilion	Science And Technology
2023.12	Daya Bay Smart Intelligent Pavilion	Science And Technology
2024.2	Smart Intelligent Pavilion of Shangbo East Hall	Arts
2024.3	Smart Intelligent Pavilion of Craft Aesthetics	Arts
2024.6	Pudong Ai Smart Intelligent Pavilion	Science And Technology

Table 1: Recent Smart Intelligent Pavilion Information Statistics.

As can be seen from Table 1, the attributes of smart intelligent pavilions opened in recent years are biased towards science and technology intelligent pavilions. A deep investigation into the characteristics of multi-modal fusion technology shows that the multi-modal fusion model can complete the integration of spatial dimension data with the same semantic support. Data of different dimensions have different properties, structures and representations, which may affect the learning ability and training effect of the model. The goal of multimodal fusion technology is to reduce these heterogeneity gaps so that different modal information can accomplish the same purpose and task. Therefore, in the design optimization of the smart intelligent pavilion, the display and service of the entire intelligent pavilion should not only synchronize the corresponding representations such as images and videos, but also complete the introduction of the corresponding text information. When one mode of data is missing, other modes can make up for it, allowing many elements to interact to produce a complete experience. The data fusion process of multimodal fusion technology in smart pavilion optimization is shown in Figure 3.

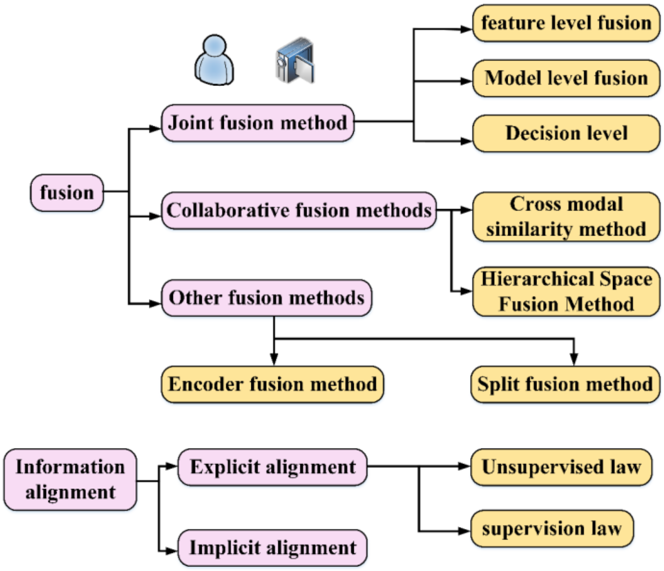

Figure 3: The data fusion process of multimodal fusion technology in the optimization of smart intelligent pavilions.

As can be seen from Figure 3, the process of multimodal data fusion includes information fusion and information alignment. In the information fusion module, three fusion methods are used to mix and cross the decision of different information feature models. The method of coding and information segmentation is used to join the supervisory training to complete the fusion task of multiple data. In the multi-modal fusion model, each layer of network structure is processed by the deep learning connection layer and the normalized attention mechanism. We map all the features of the connection layer as input variables to obtain the normalized formula:

$$X = Attention_s(Q,K,V) \tag{1}$$

$$X' = Soft\max(\frac{QK^T}{\sqrt{d}}v) \tag{2}$$

The formula, X Represents the normalized feature attention mechanism vector. The updated feature vector of the attention mechanism represents the multi-dimensional information after fusion. When the elements in the vector group are numerically multiplied, the connection layer of the neural network and the activation function together form the calculation formula of the vector group:

$$X^{"} = FFN(X)^{'} \quad (3)$$

$$X^{"} = \max(0, XW_1 + b_1)W_2 + b_2 \quad (4)$$

In the formula, $X^{"}$ It represents the parameters that can be learned in feedforward neural networks and can also be used for linear processing of multimodal feature vectors. The feedforward feature vectors are randomly extracted and expressed as:

$$mf(x) + wb^0 = E^T \quad (5)$$

Multimodal feature extraction network, combining various types of information into different module output views. Considering that most data is prone to bias in the calculation, we also set a fusion segmentation standard for special classification in the algorithm, set a classifier, and calculate cross-loss entropy using fusion features and sample labels:

$$p = classifier(F_H[0,1]) \quad (6)$$

$$p = MAX(0, F[0,1]W_0 + W_b) \quad (7)$$

According to the output classification results of the classifier, the training learning parameters can be obtained. At this time, the operation process of the feature fusion module is expressed by the following formula:

$$F = Attention_{scaled}(F_{t-1} - F, I_t) \quad (8)$$

$$WG = (\frac{T, I_0}{\sqrt{d}} f(x)) \quad (9)$$

In the formula, W Is the number of layers of feature fusion modules. The unsupervised algorithm is used to explore the categories of diversified sample information step by step. Generate corresponding labels for sound, picture and text respectively, and set the corresponding loss function. The formula is expressed as:

$$L = -\sum_{i=1}^{C} ti \lg(s_0) \quad (10)$$

All data in the multimodal fusion model are calculated as follows:

$$L_V = dm + L_S(M_0, M_1) + O \quad (11)$$

Next, the weighted fusion method is used to pool the features of the three-dimensional space model:

$$f = \sum_{i=1}^{3} a_i \zeta(f_m) \quad (12)$$

$$\sum_{ml}^{i=1} a_i = 1 \quad (13)$$

The formula f represents the extracted feature vectors under different modes and different weight indices. According to the coordinate requirements of the interior space design of the smart intelligent pavilion, the relationship between the coordinates of the exhibition area and the activity coordinates of the exhibitors is set as follows:

$$z\begin{bmatrix} u \\ v \\ 1 \end{bmatrix} = \begin{bmatrix} f,0,c \\ 0,f,c \\ 0,0,1 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = kp \quad (14)$$

Calculate the movement distance of the masses in the interior space of the Smart intelligent pavilion:

$$\begin{cases} u = f_x x_{corr} + c_x \\ v = f_y y_{corr} + c_y \end{cases} \quad (15)$$

According to the formula, the space range of the masses can be known, thus providing diversified intelligent services for visitors to the intelligent pavilion.

4 ANALYSIS OF DESIGN OPTIMIZATION RESULTS OF CAD AND MULTI-MODAL FUSION TECHNOLOGY

4.1 CAD Computer-Aided Intelligent Pavilion Design Scheme Generation

In the design of smart, intelligent pavilions, the spatial layout has always been the main factor affecting exhibitors' tour routes. The interior of the exhibition needs to automatically plan the space distribution according to different exhibits and service facilities. The traditional two-dimensional graphic design is limited by space-time and spatial coordinates, and it is difficult for pavilion designers to adjust parameters when dealing with layout schemes dynamically. In our research, we use CAD technology to assist in the spatial planning of smart intelligent pavilions and use CAD 3D modelling to expand complex scenes. According to the geometric aesthetics and the internal facilities of the exhibits, the modelling data is strengthened, and the output of the discrete hybrid model is completed after being added to the training model. The space diagram of the smart intelligent pavilion formed by this heterogeneous distributed computing modelling method is as follows:

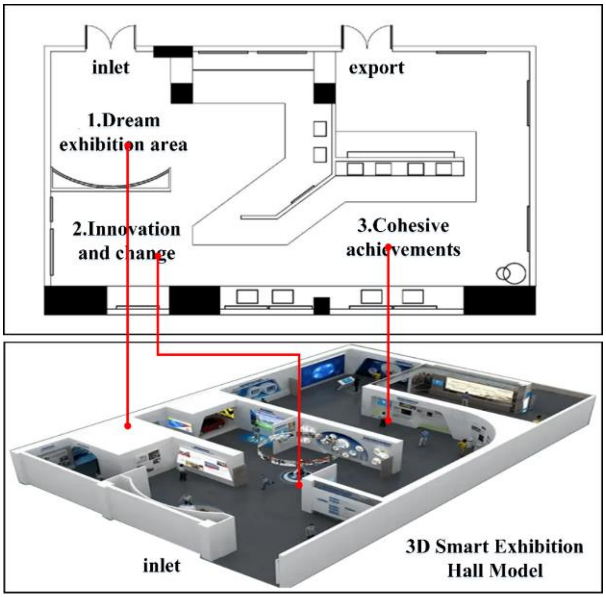

Figure 4: Two types of smart, intelligent pavilion space maps.

As can be seen from Figure 4, compared with the traditional two-dimensional plane and three-dimensional Intelligent pavilion model, the interior space optimized by CAD technology is more abundant. Next, we obtained the demand of most exhibitors for smart intelligent pavilion facilities from the mass survey, as shown in Table 2.

Facilities	*Types Of*	*Number Of People*
Public Toilets	Service Oriented	30

Drinking Fountain	Service Oriented	50
Rest Area	Service Oriented	84
Book And Information Area	Service Oriented	66
Electronic Consultation Area	Service Oriented	78
3D Virtual Interactive Area	Exhibition Type	35
Exhibition Product Introduction Area	Exhibition Type	45
Path Indexing Facilities	Exhibition Type	48
Smart Media Facilities	Exhibition Type	21

Table 2: Facilities Demand For Public Smart Intelligent Pavilions.

As can be seen from Table 2, most exhibitors can divide internal facilities into service type and exhibition type. The service facilities include public toilets, drinking tables, rest areas, book information areas, and electronic reference areas. The exhibition space contains 3D virtual interactive areas, exhibition product introduction areas, path indexing facilities, and smart media facilities. According to the demands of the masses, we can selectively enhance the attraction of the intelligent pavilion when realizing the optimization of the intelligent pavilion space to ensure the competitiveness of the smart intelligent pavilion in the same industry.

4.2 Multi-Modal Fusion Technology of Intelligent Pavilion Design Three-Dimensional Display

In the intelligent pavilion design optimization path, architecture, and art have never been separated more clearly. The exhibition building space in the intelligent pavilion building has become the carrier of art; it must become a key element in the design of space layout; the two complement each other, indispensable. Interactivity is the key to achieving the intelligent design of the intelligent pavilion. With digital technology and multi-modal fusion technology as the core, we conduct research on intelligent pavilion displays and multi-information fusion. Firstly, the relationship between the architectural space and the exhibition information elements is determined, and the combined effect of different information is obtained from the classification and sorting. And complete a certain degree of transformation in the space building to present a good exhibition mode. Before the multi-modal data model completes the information entry, the different modal data required for the smart pavilion design have been extracted to form a comprehensive amount of data to complete the representation of the model. To verify the effect of multi-modal fusion technology in combining the relationship between various data elements, we compared the changes in the complexity of information elements inside the intelligent pavilion before and after using multi-modal fusion technology, as shown in Figure 5.

As can be seen from Figure 5, the complexity of information elements inside the intelligent pavilion rises sharply after the use of multi-modal fusion technology. It includes not only the intelligent display of the pavilion map but also the information on the exhibition content of each floor of the pavilion. Users can use various facilities according to their needs. In addition, the key query of intelligent pavilion information is also one of intelligent design. Through the small program, users can automatically obtain fare information, opening hours, traffic routes, and other content. The smart pavilion is fully covered with Bluetooth facilities and provides a real-time location function.

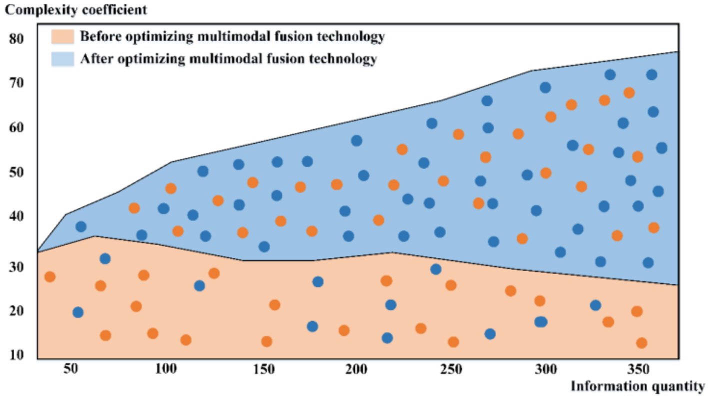

Figure 5: Changes in the complexity of information elements inside the intelligent pavilion before and after multimodal fusion technology.

When users enter the pavilion and turn on the Bluetooth, they can obtain their position at any time and complete the identification of the floor. To obtain the path to the exhibition area or service facilities, users can customize the start and end points to plan the optimal path and carry out synchronous navigation functions and voice explanation services. It can be seen that the design application of smart intelligent pavilions contains more diversified information. Therefore, we conducted a statistical analysis on the number of visitors' visits to the intelligent pavilion and the income of the intelligent pavilion before and after the optimization with multi-modal fusion technology:

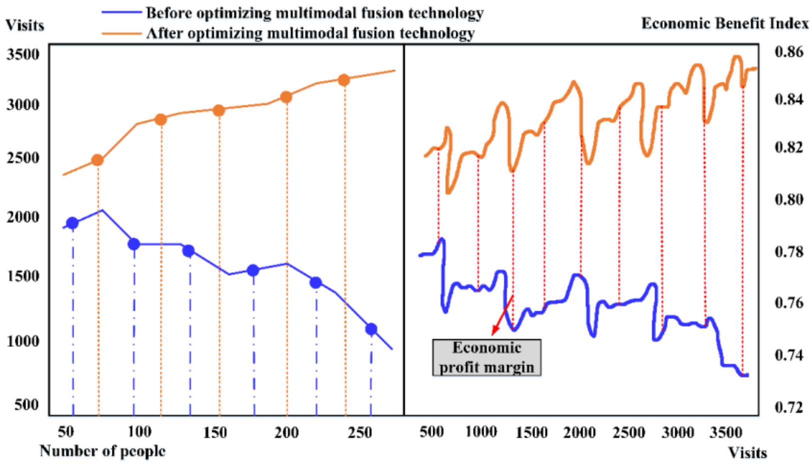

Figure 6: Number of Visitor Visits and Intelligent Pavilion Revenue.

As can be seen from Figure 6, the same data information is randomly selected as the detection source, and the number of visitors to intelligent pavilions is improved in a straight line after multi-modal fusion optimization. At the same time, most people have a high degree of acceptance of the smart, Intelligent pavilion design, and the economic benefits brought by the number of visits have been significantly improved. In the smart pavilion platform, we can also view the cumulative passenger flow and new passenger flow of nearly one hour in real time, observe the distribution of customers to the store and the use of facilities, and dynamically adjust the corresponding service measures.

5 CONCLUSIONS

With the gradual increase in people's living standards, the spiritual needs of the masses are constantly changing. Traditional pavilions are important carriers for culture and knowledge dissemination and display. They are mainly responsible for the preservation and research of products, and cannot meet the visitors' demand for wisdom and diversity of pavilions. Therefore, this paper uses CAD computer-aided and multi-modal integration technology to optimize the design of the smart intelligent pavilion, to improve the tourist experience. Firstly, from the business system and space layout of the intelligent pavilion, the existing problems are analyzed. The layout information in 3D modelling is dynamically adjusted according to the needs of the masses for the internal facilities of the smart intelligent pavilion and their spatial planning preferences. Using CAD computer-aided tools, Transform the two-dimensional intelligent pavilion space design drawing into a three-dimensional model, realize the parameter design optimization in the three-dimensional model, change the traditional layout format, and add an immersive space experience. In 3D modelling, the formula of interference noise is optimized to improve the overall quality of the CAD technology. Finally, multi-modal fusion technology is used to combine multi-data information such as sound, text, image and video into the internal functions of the smart intelligent pavilion. The multi-modal fusion model is used to complete the three-dimensional retrieval task, extract the characteristics of the masses' preferences, add the fusion data training process, and randomly extract the experimental data source to evaluate the use effect of the optimized design of the smart pavilion. The research results show that CAD and multi-modal integration technology have shown good performance in the process of realizing the design optimization of a smart intelligent pavilion and can make users experience intelligent, diversified, and immersive visiting feelings.

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