Research Article

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Architectural design visual information mining system based on image processing technology

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Abstract: With the rapid development of modern society and economy, various types of science and technology have also achieved relatively rapid development, which has led to significant changes in all walks of life in modern society. This change not only makes modern society transition toward an information society but also makes people in modern society obtain more convenience. The construction industry has also achieved higher quality development with the development of science and technology, especially through the informatization reform of existing technical means in multiple processes such as building design and construction, which has saved a lot of manpower and material resources. The most important aspect in the field of architecture is the design work before construction, and the degree of refinement in this process also determines the merits of the building to a certain extent. Therefore, the field of architectural design has also received more attention from relevant researchers. At the same time, the further development of social economy in the new era also puts forward more requirements for architectural design in the construction industry, which urges researchers to conduct in-depth research on existing architectural design. At the same time, combining some emerging information technologies, a new architectural design mode with better structure and performance is proposed. Image processing technology mainly uses computer algorithms to collect images, thereby converting these images into digital signals that can be recognized by a computer, and then displaying them on a computer display. This image processing technology can also identify and extract information from images, thereby displaying the key information therein. This article mainly analyzes image processing techniques and some data analysis algorithms to obtain the feasibility of their application in visual information mining systems for architectural design. The contribution of this study is to propose a new architectural design visual information mining system based on image processing technology and data analysis algorithms, and conduct experimental studies to prove that it is superior to existing systems in terms of information extraction accuracy, processing speed, and user convenience. The experimental results show that compared with the existing architectural design data mining system, the new system has an average performance improvement of 25.9% in many aspects, which marks an important step forward in the field of architectural design informatization. In addition, this study also provides a new perspective for the construction industry, i.e., applying image processing and data analysis technology to the design process to improve design quality and efficiency.

Keywords: architectural design, visualization technology, information mining, image processing technology, wavelet transform denoising, threshold segmentation algorithm, data analysis algorithm

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1 Introduction

With the rapid development of information technology, the functions attached to buildings begin to develop toward diversification and composition, which also leads to the increasingly complex architectural space. The existing architectural design models in the current society can no longer meet some of the needs of people for architectural construction. Only by combining architectural construction models with various information technologies can this situation be improved. This building construction model that combines information technology not only can further improve work efficiency, but also can help staff save more unnecessary energy, leading to more sophisticated building construction.

The innovation of this work lies in the development of a new architectural design visualization information mining system that integrates image processing technology and data analysis algorithms. This system has achieved a major breakthrough in the field of architectural design. This system not only optimizes the efficiency of the design stage, but also significantly improves the quality and accuracy of the design drawings. The article deeply explores the key role of image denoising, enhancement, and segmentation technology in improving design details. At the same time, the application of visualization technology further optimizes the architectural design process. The integration of these technologies has brought an innovative information-based design and construction method to the construction industry, driving the industry toward a more efficient and precise future.

2 Related work

Some researchers have investigated and analyzed the current development situation of the architectural field in the current society. Oraee explored the role of an information model in the construction process. Through research on the optimization effect of this technology on existing building construction models, he determined the development direction of the construction industry over a period of time [1]. Hong explored the application of a data analysis method in the construction process of small and medium-sized buildings. Through an investigation of the effectiveness of using this method in the construction of small and medium-sized buildings in a certain area, he determined the effectiveness of this method [2]. Jin explored the role of information analysis methods in construction project management. Through a survey of the development of the construction industry in a certain region over a period of time, he identified the role of this information analysis method in promoting high-quality development of the construction industry [3]. Salama explored the application of architectural theory in urban design and determined the significance of this theory [4].

Abd Jamil and Fathi explored the role of information analysis in the construction process in the management of conceptual design and facility construction in the construction industry. By using a relatively novel literature analysis method to analyze the relevant data, he identified the role of the building's information analysis function in the entire construction process [5]. Buniya explored the obstacles in the real-time process of a safety plan in the construction industry. By using the method of literature review to investigate the implementation process and effectiveness of a safety plan for the construction industry in a certain area, he identified the obstacles and some solutions to the implementation of safety plans in the current construction industry [6]. Gunduz and Yahya explored the successful experiences of most projects in the construction industry. Through a survey of the archives of some cases in the construction industry in the region, they identified several key factors necessary for a successful project in the construction industry, and conducted research on the focus of these key factors [7]. After analyzing a large number of building construction patterns, the researchers identified some shortcomings in the current architectural field.

Researchers in other related fields have conducted in-depth analysis of architectural design patterns in the hope of obtaining a more complete architectural design pattern. Dixit explored the role of a management practice approach in the architectural design process. Through a literature review of the effectiveness of a management method in the architectural design and construction process in a certain area, he determined the importance of this method in the architectural design process [8]. Uchida et al. investigated the experience of

teaching architectural theory in schools in a certain area, and determined the effectiveness of this architectural theory in teaching [9]. Gunawardena and Mendis explored the performance of various architectural design and construction modes in the current society. Through in-depth research on the performance of various architectural design and construction methods, he determined that a prefabricated architectural design and construction model has good performance in many aspects [10].

Li explored multiple factors that affect the investment risk in a prefabricated architectural design and construction model. By using a systematic approach to analyze the multifaceted performance of this prefabricated architectural design model and the success rate of architectural projects using the prefabricated design model in history, he determined the reliability of this prefabricated architectural design model [11]. Antonina et al. explored the expression of a modular architectural design and construction model. Through multiple experiments to study the performance of such modular architectural design patterns, he determined the feasibility and reliability of such modular architectural design and construction patterns [12]. However, these researchers' research on existing architectural design models cannot support their efforts to propose a comprehensive architectural design model, requiring more comprehensive analysis.

3 Image processing technology

The high-quality development of modern society and economy has led to the rapid development of information technology. The cross use of artificial intelligence technology and various information technologies in multiple fields has also led to a higher quality development of a series of things in the current society, such as technology, economy, and culture. In the traditional construction industry, workers often need to spend a lot of manpower and material resources to complete a building's surveying and mapping work. In this process, an emerging information technology, namely, image processing technology, is used [13]. To some extent, image technology is a branch of artificial intelligence technology, which uses computers to process images and information in images [14]. In the current society, image processing technology has been able to better complete the digitization, enhancement, restoration, segmentation, and recognition of images.

In architectural design, geometric image processing is not only a tool for visual presentation but also an essential means for ensuring design accuracy and validating outcomes. Specifically, image rotation typically relies on a rotation matrix in a two-dimensional plane; by multiplying the coordinates of the architectural model with this matrix, designers can precisely control the model's rotation angle around a designated center. This technique allows for an intuitive display of a building's appearance from various angles when presenting its different facades and spatial layouts, thereby aiding in the assessment of how the building harmonizes with its surrounding environment, sunlight direction, and landscape integration. On the other hand, image scaling is generally achieved by using a scaling factor–each coordinate of the model is multiplied by a fixed scaling coefficient, resulting in a uniform enlargement or reduction in size. This process ensures that, while the architectural model is resized, the relative proportions of its components remain unchanged, thereby maintaining accurate proportional relationships in design blueprints, model demonstrations, and virtual reality presentations. Furthermore, modern architectural design software typically integrates geometric transformations such as rotation and scaling into 3D modeling via matrix operations, enabling real-time rendering and multiangle displays, which significantly enhance design efficiency and project visual precision.

Image processing technology in the field of architecture can not only play a good role in the design of buildings but also play a very important role in the construction process of buildings. First, in the architectural design stage, image processing technology and related software can greatly save the time of architectural design related staff, and complete a large amount of repetitive work in the architectural design process through related software and algorithms. On the other hand, image processing technology can help relevant staff to achieve multi-angle architectural design selection work, while accurately controlling the color gamut in the architectural design process. In addition, image processing technology in the construction phase can also help construction personnel complete the clear processing of building related images under various extreme weather conditions, and this can also help construction management personnel control the overall

construction progress and quality of the building. Image processing technology can also be used as a major design tool to replace the traditional pattern of hand drawn architectural design drawings. The partial processing mode for images in image processing technology is shown in Figure 1.

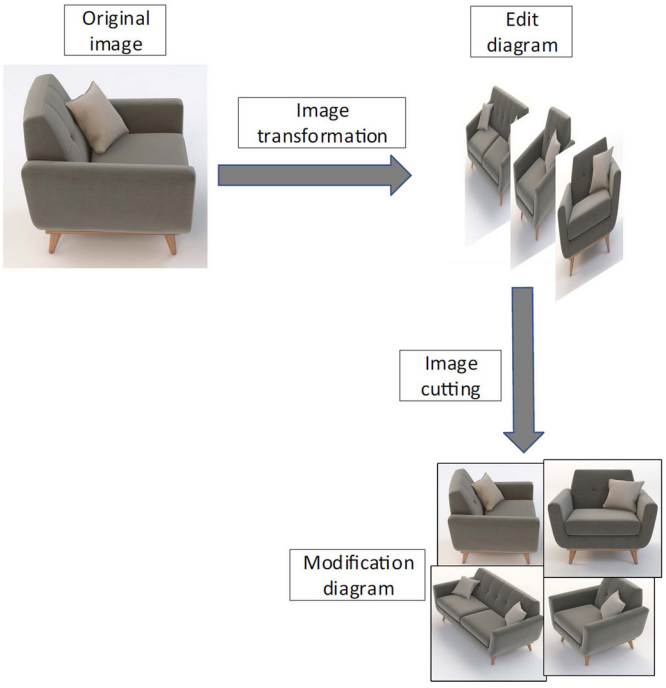

Figure 1: Schematic diagram of some image processing modes in image processing technology. The 3D model in this image is sourced from Turbosquid [15], created by 3DReady, and has been authorized for commercial use.

4 Architectural design and visualization mode

With the deepening of architectural research in the current society, relevant researchers have discovered that architecture has two attributes: virtual and reality, and the main goal in the field of architecture is to complete the virtual architectural design into a real architecture [15]. With the rapid development of various information technology means in society, researchers in related fields are also rapidly increasing their attention to virtual attributes in the construction industry, and architectural design has therefore received more attention. Among them, visualization technology is a technology that can strengthen the virtual properties of buildings. Visualization can complete the analysis of relevant information through computers, thereby displaying this information in the form of images. Therefore, the combination of architectural design patterns and visualization technology can not only enable a more complete display of various data in the architectural design process, but also save significant effort on the part of relevant staff. The visualization of architectural design has multiple meanings at the same time, and it is the connecting medium between virtual design and actual construction process in the construction industry. As a powerful communication and analysis tool, architectural design visualization not only promotes effective communication between designers, clients, and construction teams, and presents complex architectural concepts and data in the form of intuitive images but also provides key support in design evaluation, construction simulation, material planning, marketing, education and training, and protection of historical buildings. It plays a vital role in the entire life cycle of a construction project. The general architectural design process is shown in Figure 2.

From another perspective, the visualization of architectural design also faces considerable challenges. The first is the challenge of learning and applying visual patterns in architectural design. In the visualization mode of architectural design, architectural visualization can also be used as an important tool for architectural data

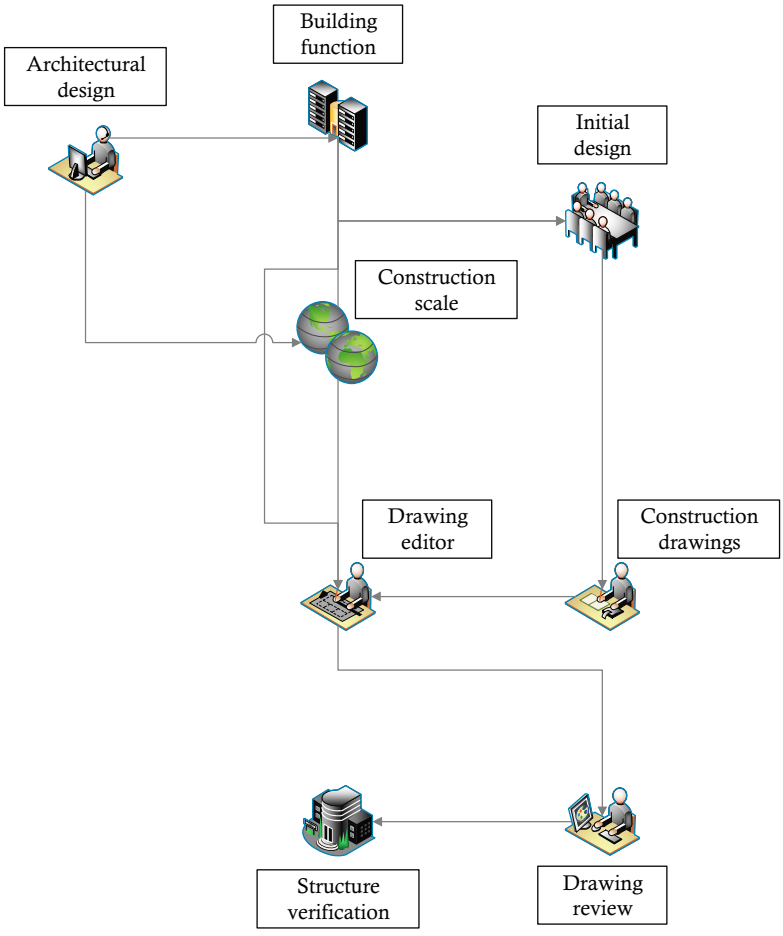

Figure 2: Schematic diagram of general architectural design process. Source: Created by the author.

analysis and information transmission. The data analysis work can digitize some contradictions in architectural design, and then calculate their rationality through relevant algorithms. On the other hand, the visualization method of architectural design can emphasize the visual transmission of architectural related data information, while applying the technical path of architectural design. The application process of visualization technology in architectural design is shown in Figure 3.

Figure 3 shows the complete process of data processing starting from the data center, going through multiple key stages such as integration, processing, analysis, and classification, and finally reaching data mining. It emphasizes the importance of building data interfaces in connecting various links, and mentions data visualization as a key means of presenting results.

5 Research on image processing in architectural design

The rapid development of the construction industry not only provides key basic support for the high-quality development of the social economy but also makes various related technologies of architectural design begin to seek further development. At this time, the rise and rapid development of various emerging information technologies make it possible to establish new models of architectural design. Many people in the current society have started to use relevant professional software in computers to create architectural design. This approach to building design through the use of relevant professional software in computers can not only improve overall work efficiency but also enable editing and modification of unreasonable parts of different

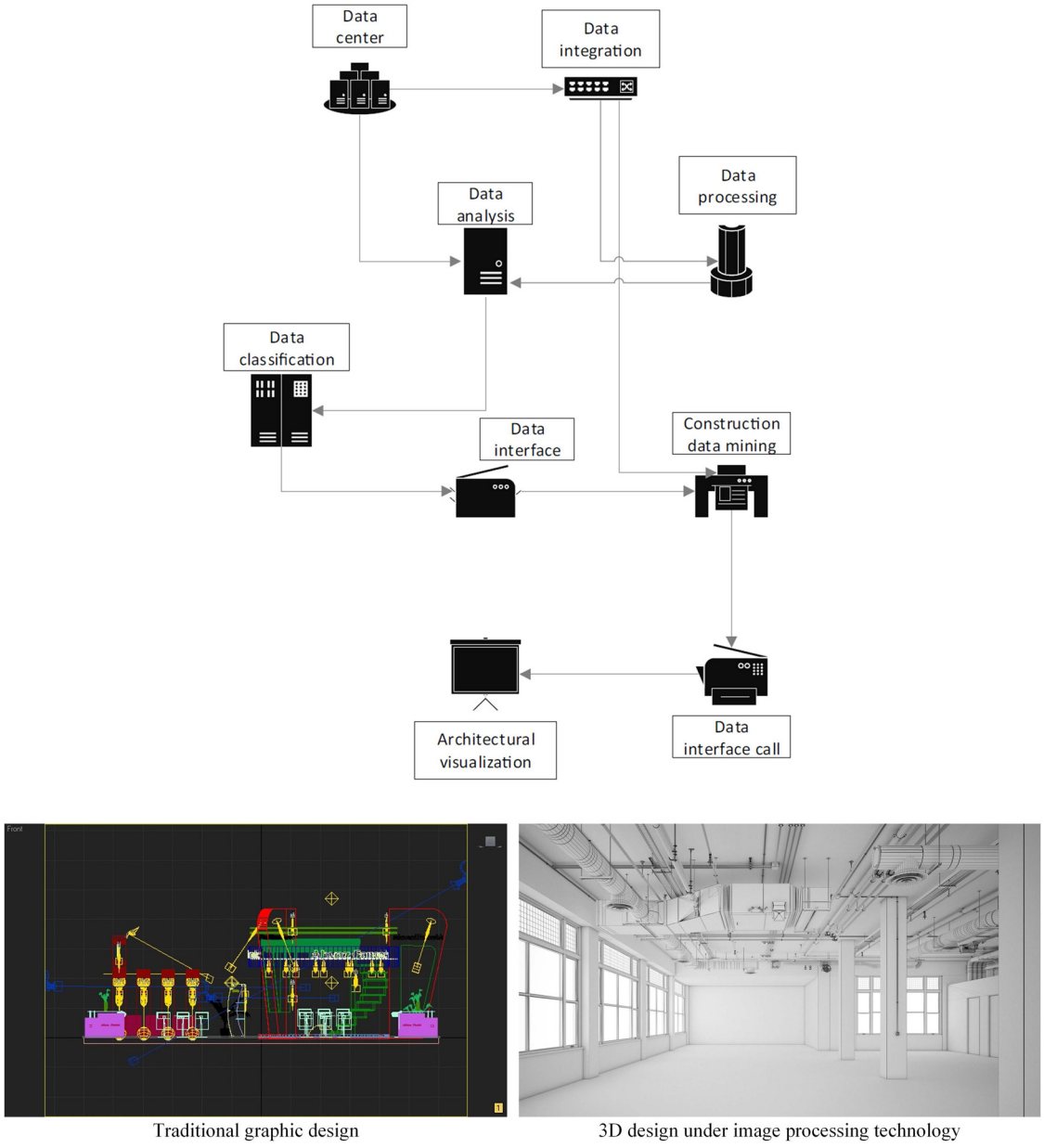

Figure 3: Schematic diagram of the application process of visualization technology in architectural design. Source: Created by the author.

buildings in multiple time periods, which greatly saves human and material costs. On the other hand, this architectural design model is limited to a single plane, and cannot visually observe multiple places in the building in real-time, and cannot effectively test the structure of the building. Therefore, a more intuitive architectural design model is also needed. At this time, the rise and development of visualization technology makes this more intuitive architectural design model possible. The combination of architectural design and visualization technology helps relevant staff to design better works within the same time frame.

The visualization of architectural design uses image processing technology, which is essential for modern digital design, and can significantly improve design efficiency and creative display. Among them, image denoising, enhancement, and segmentation techniques are very critical. They can help architects extract effective information from the original image, improve the quality and accuracy of design drawings, and make the design intent clearer and easier to understand.

5.1 Image denoising

In the early stages of architectural design, image quality is essential. However, images obtained from fieldwork or aerial photography are often affected by noise due to factors such as equipment limitations and lighting changes. At this time, image denoising technology has become the key, which can effectively eliminate interference such as spots and blurs, and make the image clearer [16,17]. There are various denoising methods, such as median filtering to remove salt and pepper noise, mean filtering to smooth the image, and wavelet transform to remove noise while retaining details [18,19]. Through the precise selection of denoising algorithms, designers can obtain high-quality images and lay a solid foundation for architectural design and creation.

In this work, wavelet changes are used to denoise the collected architectural images. Excess noise $n(a, b)$ is filtered out to obtain a grayscale image $n_1(a, b)$ $c(a, b)$. The formula is as follows:

$$A(a, b) = n(a, b) + n_1(a, b)c(a, b) \rightarrow n_1(a, b)c(a, b). \tag{1}$$

Among them, the pixel of image A is (a, b); the noisy image is $A(a, b)$; the noise map models are $n(a, b)$ and $n_1(a, b)$; and $c(a, b)$ is the original file of the image.

When the grayscale image is greater than or equal to 0, $-\infty$ does not appear in the logarithmic operation, i.e., the grayscale value is equal to 0. $n_1(a, b)$ $c(a, b)$ can be added by $\lim\varepsilon \rightarrow 0^*$, i.e., $n_1(a, b)$ $c(a, b) + \varepsilon >$ is noise. The specific denoising results of the architectural image after the wavelet change are shown in Figure 4.

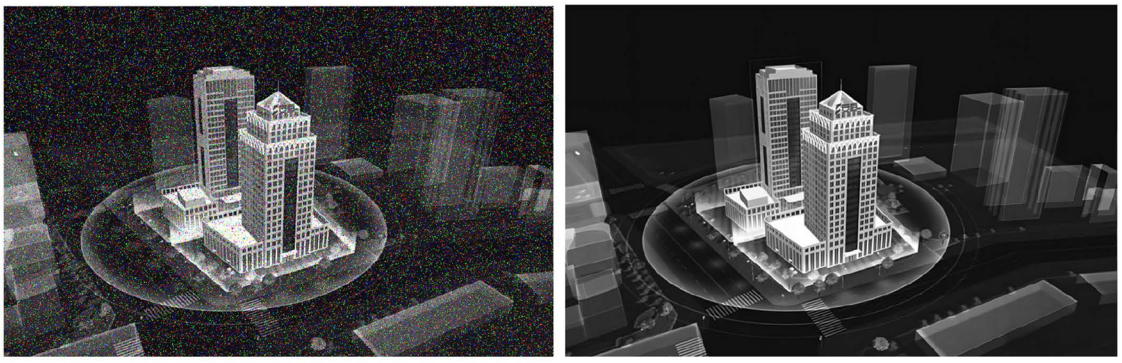

Figure 4: Comparison of image before and after image denoising processing. Source: Created by the author.

The contribution of denoising algorithms in the initial design phase is evident. Photos or aerial images of building sites in architectural design are often subject to noise interference, which is caused by the limitations in shooting equipment or changes in ambient lighting. By using denoising algorithms, such as wavelet transform, noise and blur in images can be effectively eliminated, allowing designers to obtain clearer image foundations and more accurately design building contours and structures. Denoising processing can also provide a good input foundation for subsequent enhancement and segmentation operations, ensuring that every detail of the design can be reflected in a clean image.

5.2 Image enhancement

Image enhancement technology is essential to improve the visual quality and information recognition of images [20,21]. When the light is low or the contrast is low, the technology highlights key features in the image by adjusting the brightness, contrast, saturation, and sharpness. In architectural design, image enhancement can optimize the texture, light and shadow effects, and spatial relationships of architectural materials, such as enhancing contrast to highlight structural levels, adjusting colors to reflect the true colors of materials, and

helping designers choose materials rationally. In addition, high dynamic range technology can capture full details and show the true beauty of buildings in complex lighting environments, further enhancing the application value of images in architectural design. In this study, the balanced histogram is used to enhance the image. The image enhancement results are shown in Figure 5.

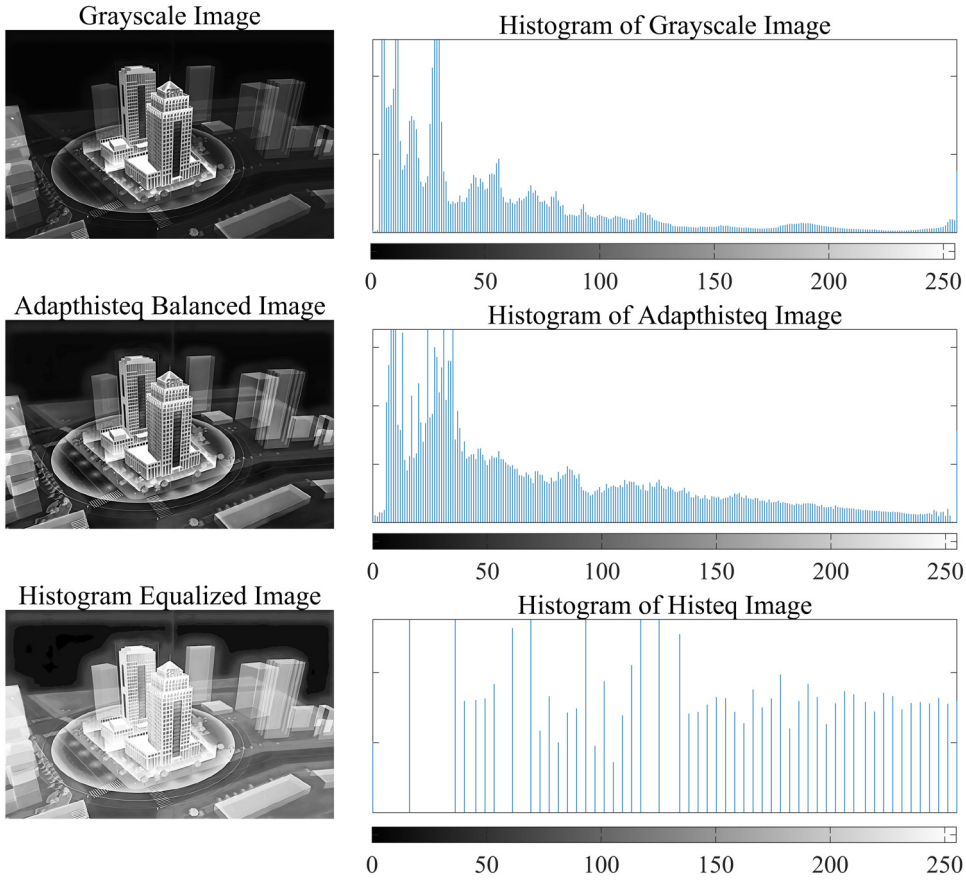

Figure 5: Image enhancement result. Source: Created by the author.

The image enhancement algorithm greatly improves the visual effect of designed images. By adjusting parameters such as brightness, contrast, and saturation of the image, enhancement techniques effectively highlight key features of the building structure. In situations where there is insufficient light or low contrast, enhancement technology helps designers better present the texture, light and shadow effects, and spatial relationships of materials, thereby more realistically restoring the texture and hierarchy of buildings in design renderings. This improves the visual quality of the design drawings and helps designers and clients understand the design intent more intuitively.

5.3 Image segmentation

In image processing technology, the image to be analyzed is usually segmented first. The application of image segmentation technology in architectural design is crucial. By dividing the image into multiple regions with similar attributes, architects can more accurately identify and analyze the various components of the building. Image segmentation algorithms generally use threshold segmentation algorithms [22,23].

Threshold segmentation, as the most commonly used image segmentation algorithm, is also a commonly used technology in many industries in society because it does not require a large amount of computation

during use and its performance is relatively stable. Threshold segmentation algorithm is a commonly used technique in image processing to divide an image into different regions or objects. The core idea of this algorithm is to segment an image into background and foreground (or multiple regions) based on the grayscale value of the pixel. The threshold refers to the grayscale boundary used to distinguish different regions. When the grayscale value of a pixel is above or below this threshold, it is assigned to different categories. By analyzing the grayscale histogram of the image, an appropriate threshold is automatically determined using the Otsu algorithm. This threshold is then applied to segment the image into building and non-building areas. In this process, pixels with grayscale values above the threshold are identified as part of the building, while those below the threshold are regarded as the ground or other background. In order to improve the accuracy of the segmentation, morphological operations can be further used to eliminate small fragments caused by image noise or sensor errors and fill any small holes in the building area. This segmentation not only helps to identify and classify buildings but also provides a solid foundation for subsequent image analysis and building feature extraction.

In threshold segmentation, it is first necessary to calculate the variance between pixels in the image, and the formula is shown below.

$$a^2 = p_l(m_j - m_g)^2 + p_r(m_r - m_g)^2, \tag{2}$$

where m_j and m_r represent different pixel averages, while m_g represents the overall average of pixels, and p_l and p_r represent the proportion of each target pixel to the overall pixel. Then, the grayscale value k of the image is solved, and the formulas are shown below.

$$k_l = \frac{1}{p_l}\sum_{i=1}^{n} ip_i, \tag{3}$$

$$k_r = \frac{1}{p_r}\sum_{i=n+1}^{255} ip_i, \tag{4}$$

where i represents the number of pixels participating in the operation. Then, the first-order cumulative matrix of gray levels is calculated as follows:

$$y = \frac{(m_g \times p_l - m)^2}{p_l(1 - p_l)}. \tag{5}$$

Then, a support vector machine algorithm is used to analyze the image and perform content segmentation operations, generally based on a sample dataset composed of image pixels obtained after image segmentation. First, it is necessary to divide the plane formed by the sample dataset, and the main formula used is shown below.

$$y = a^w x + b, \tag{6}$$

where a represents the normal vector; b represents the offset of the data; and a^w represents the weight of the plane. Next the overall partial derivative operation is performed on the sample dataset, using the below formula.

$$y = \sum_{i=1}^{m} a_i y_i x_i, \tag{7}$$

where a_i, y_i, and x_i represent different sample data parameter values, respectively. Finally, the Lagrange operation model is used to calculate the constraints of the entire plane, using the below formula.

$$L = \frac{1}{2}w^2 + \sum_{i=1}^{n} a_i(1 - y_i). \tag{8}$$

The addition of the above two different computational models helps to further optimize the computational process of the visual information mining system for architectural design, and this structural optimization also greatly improves the overall work efficiency. On the other hand, these two algorithms also make it easier for

people to analyze the visual models of architectural design patterns, and they can obtain all the data in a more complete architectural design without paying a lot of labor costs. This also provides great convenience for the construction of buildings, thereby enabling the development model of the construction industry to better meet some of the current social needs. The specific renderings before and after image segmentation are shown in Figure 6.

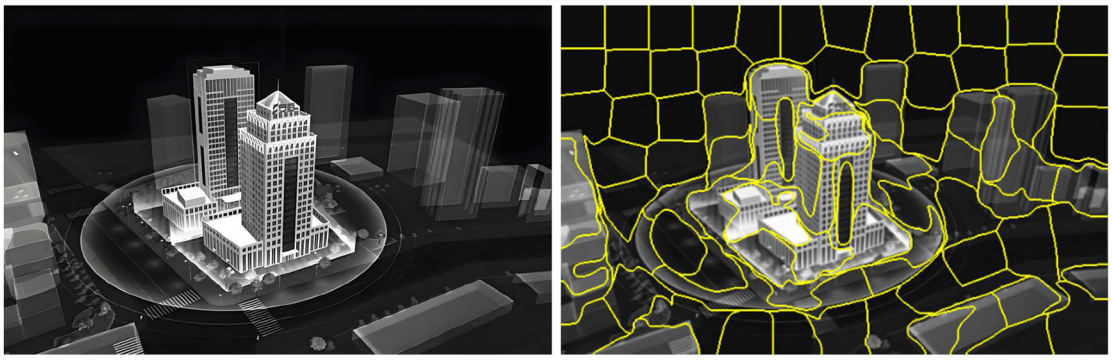

Figure 6: Renderings before and after image segmentation. Source: Created by the author.

Image segmentation algorithms are crucial for accurate analysis and recognition of various components of buildings. In architectural design, image segmentation technology is used to divide building images into multiple regions with similar attributes, helping designers to more clearly distinguish between different structures and materials of the building. Threshold segmentation algorithm, as a commonly used segmentation technique, can quickly and accurately separate the main body and background of a building without increasing a large amount of computation. This segmentation method not only lays the foundation for the subsequent processing of architectural design, but also provides necessary data support for building information extraction and structural analysis.

6 Experiment on visual information mining system for new architectural design

The current development of various information technologies has provided more impetus for the innovation of development models in various industries, and this has also led many industries to consider integrating various information technologies into the industry, thereby being able to better adapt to the current social development process. The development of the construction industry has attracted the attention of researchers in many related fields. Architecture has always been the foundation of residents' lives and work in the process of social development. It can also provide better impetus for high-quality socio-economic development. However, the rapid development of social economy has made the current development model of the construction industry increasingly unable to meet some of people's needs, which has also prompted the construction industry to propose a new model that more meets the current social development needs. The construction industry under this new model not only needs to ensure the safety of staff during the construction process but also to deliver complete buildings within the prescribed time. Therefore, this article mainly studies the foundation of building construction, namely, the design mode of buildings. Through in-depth analysis of existing image processing technology, it determines the feasibility and reliability of a visual information mining system for building design based on image processing technology. This new visual information mining system for architectural design can not only collect key data from multiple aspects of architectural design but also improve the overall efficiency of architectural design to meet the full range of needs of the development of the new era.

This system adopts a modular architecture in its design, ensuring that each functional module is independent of each other. Different modules can be developed, tested, and upgraded separately without affecting the operation of other parts. The core functional modules such as image denoising, enhancement, segmentation algorithms, etc., are encapsulated as independent modules and interact with other parts of the system through standardized interfaces for data exchange. This allows for easy replacement or addition of new algorithms when they appear, without the need for large-scale modifications. At the same time, the system divides the user interface, data management, and image processing functions into different levels. The user interface is responsible for interacting with the system and connects the data management and image processing modules through flexible API interfaces. The data management module is responsible for data storage, retrieval, and preprocessing, ensuring efficient and secure data transfer between modules. In the module design process, an object-oriented programming approach is adopted to make functional components reusable and extensible. Seamless integration of modules is achieved through standardized communication protocols and middleware, allowing for collaborative operation even when modules are independently updated or replaced. In addition, the system introduces a plug-in design that allows for dynamic loading or unloading of functional modules according to requirements, ensuring that with the emergence of new technologies such as deep learning algorithms, the system can flexibly integrate these new technologies and continuously improve performance without modifying the main architecture.

Image data of diverse construction projects are widely collected, covering all stages from preliminary design to construction completion. In order to ensure the smooth progress of the experiment, advanced image processing software and data analysis tools are selected, and the proposed information mining system is fully built and debugged to adapt to the image processing requirements of different resolutions and complexities. For the purpose of enhancing the universality and persuasiveness of the experimental results, the architectural design image dataset used in this study covers various types of architectural styles and regional characteristics, covering architectural designs from traditional to modern, from different cultural backgrounds to different climate conditions.

First, the role of information mining and analysis in architectural design at different stages in the architectural field is analyzed, as shown in Table 1.

Table 1: Role of information mining and information analysis in architectural design in different stages of architecture

	Architectural design	Building construction
Information mining	6.5	7.8
Information analysis	5.3	8.2

With the continuous progress of socio-economic and scientific and technological means, the current architectural design and construction models in society have become increasingly unable to meet people's needs. Therefore, there is a need for a model of architectural design and construction that combines emerging information technology to promote high-quality socio-economic development. First, this article studies the role of information mining and information analysis in building design and construction in Table 1, and determines that information mining plays a good role in both building design and construction, but more importantly, it serves building construction. The accuracy and scientificity of building related information can also directly have a significant impact on the rationality of the overall structure of the building. Therefore, it is necessary to improve the information mining and analysis capabilities for the entire building during the architectural design process to ensure the structural rationality of the entire building.

The images are preprocessed to remove noise and enhance image features, and then a customized algorithm is applied to extract key visual information. Next a series of data analysis techniques are used to dig deeper into the extracted data to identify core elements and patterns in the building design and construction process. In the system testing phase, the performance of the system is evaluated through multiple datasets from different building projects, with a special focus on the accuracy of information extraction, processing speed, and user convenience.

Comparative analysis is used to compare the new system with traditional methods on multiple key performance indicators. In addition, a case study method is used to explore the actual effect of the system when processing specific building projects. User feedback is collected to evaluate the practicality of the system, and a series of quantitative performance evaluation indicators provide objective data on the performance of the system. In order to gain a deeper understanding of users' real feelings about using the system, this study not only collected quantitative user feedback, but also conducted user interviews to explore users' experiences and improvement suggestions for the system during use. These qualitative feedbacks provide important guidance for further optimization of the system.

The rapid development of information processing technology in the field of architectural design provides important support for improving design efficiency and accuracy. Various advanced image processing technologies have their own characteristics in data acquisition, analysis, and processing, but their actual application effects and user experience vary. To gain a deeper understanding of the performance of different technologies, this article compares its own system with convolutional neural network (CNN) and image super-resolution reconstruction techniques. The results are shown in Table 2.

Table 2: Comparison between architectural design information processing system and advanced image processing technology

Comparison metric	The proposed system	CNN	Image super-resolution reconstruction
Data processing score	8.1	7.5	7.3
Image denoising accuracy (%)	92	88	85
Modularity flexibility score	9	7.5	7
User convenience score	8.2	7	6.5

According to the data in Table 2, the system in this article outperforms CNN and image super-resolution reconstruction techniques in all indicators. Especially in terms of data processing score (8.1), image denoising accuracy (92%), and modular flexibility score (9.0), this system performs outstandingly, demonstrating its significant advantages in information processing efficiency and flexibility. In addition, the system in this article also has a higher user convenience rating (8.2) than other technologies, indicating that it can provide a better user experience in practical applications. This system has a significant competitive advantage in improving the efficiency and accuracy of architectural design.

Then, this article analyzes the relationship between architectural design and construction in a certain area over a period of time and their respective development, as shown in Figure 7.

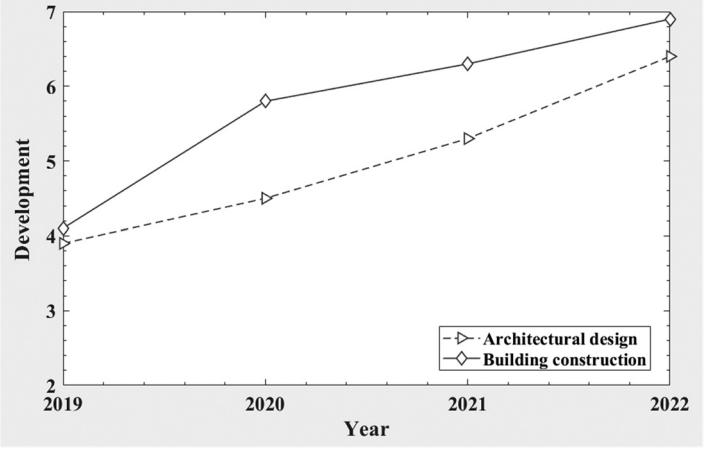

Figure 7: Schematic diagram of the development of architectural design and building construction in a certain area over a period of time. Source: Created by the author.

In the current era, the development of social economy and the rapid development and maturity of various information technologies have led to rapid and high-quality development in the field of architecture. With this transformation of social informatization, the requirements for informatization in the construction field are also continuously increasing. Therefore, a new development model in the construction field that combines information technology has become the research focus of researchers in the construction field. In the field of architecture, it is generally possible to divide all processes of a building into two major stages. The first stage is the overall design stage of the building, in which the appearance and structure of the building are generally determined. At the same time, in the architectural design stage, it is also necessary to analyze the information of the building to ensure the reliability of the overall structure of the building. On the other hand, it is building construction, which refers to manufacturing the building according to the drawings in the architectural design stage. During the construction phase, it is also necessary to refer to the relevant information of architectural design for building manufacturing to ensure that the final building meets the expected goals.

After analyzing the development of architectural design in the region in the past four years in Figure 7, it can be determined that the development of architectural design in the past four years has shown an upward trend, and the growth rate of its development is also increasing over time. On the other hand, based on the analysis of the development of building construction in the region in the past four years as shown in Figure 7, it can be seen that building construction has achieved good development in the region during this period, but the development speed is relatively slow. This situation also indicates that the current architectural design and construction mode has become increasingly unable to meet the needs of social development.

Next the development and application of visualization technology and image processing technology in the same period in this area are analyzed, as shown in Figure 8.

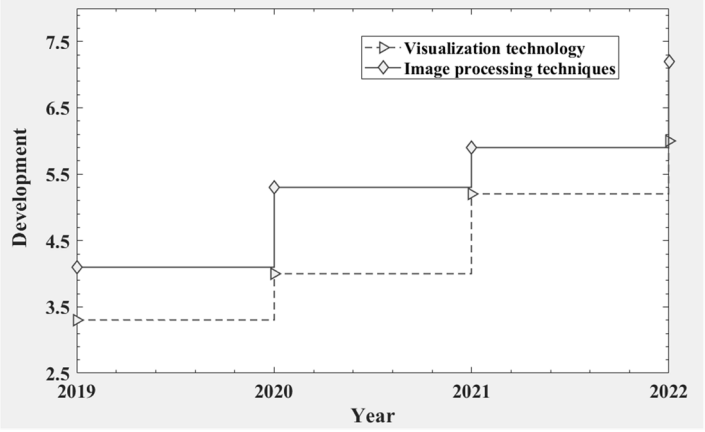

Figure 8: Schematic diagram of the development and application of visualization technology and image processing technology in a certain region over a period of time. Source: Created by the author.

The rapid development of various technologies in the computer field has had a significant impact on the development of various industries in the current society, especially in the construction field. In the current society, the information conveyed by people in communication and work is no longer limited to text and voice, but is developing toward multiple types, with image being a more intuitive way of communication emerging during the development of information technology. Hence, there rises the need for people to analyze and process a large amount of image data in their daily lives and work. Based on this, an image processing technology was proposed. This image processing technology is based on artificial intelligence related technologies and can help computers complete tasks such as image recognition and data extraction. Visualization technology is to convert two-dimensional images in a computer into three-dimensional images, thereby helping people to perform more intuitive viewing and editing operations on images.

After analyzing the development and application of visualization technology in the region in the past four years in Figure 8, it is clear that this visualization technology has a good development trend in the region in the past four years, and its development speed is also slowly increasing. This situation also indicates that the application degree and depth of visualization technology in this region are further improved, and the development potential of visualization technology is large. On the other hand, after analyzing the development of image processing technology in the region in the past four years in Figure 8, it can be found that the development of image processing technology is relatively stable. However, due to the high starting point of development of image processing technology, image processing technology is significantly more mature at the same time point.

Finally, it is to study the performance of the new visual information mining system for architectural design proposed in this study combined with image processing technology and existing architectural design information mining systems in various aspects, as shown in Figure 9.

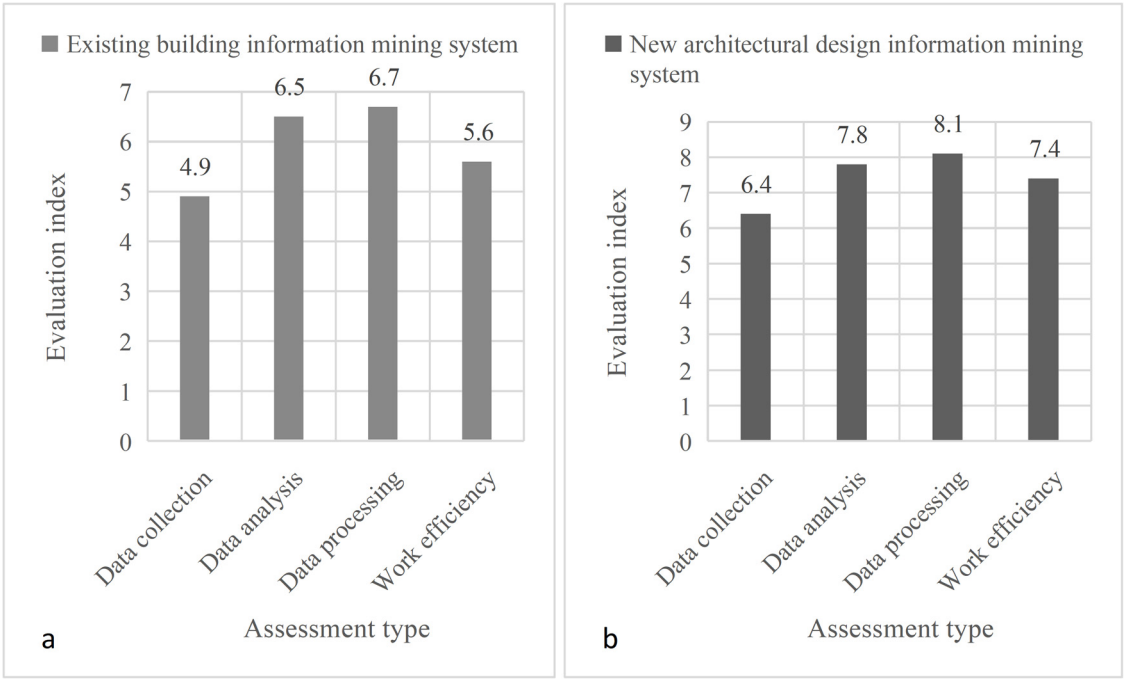

Figure 9: Schematic diagram of (a) the existing architectural design system and (b) the performance of the new architectural design visualization system based on image processing technology. Source: Created by the author.

The development of various technologies in the current society has led to a rapid increase in the scope and depth of application of various technologies in multiple industries, and has also brought more convenience to people's lives and work. The application of image processing technology and visualization technology in the field of architecture also confirms this point. The combination of visualization technology and existing architectural design patterns enables relevant staff to edit buildings in a more intuitive manner. Image processing technology is capable of analyzing and extracting data from building models during this architectural design phase, which further improves the efficiency of architectural design. On the other hand, such information mining and processing can not only have a positive impact on the architectural design stage but also have an important impact on the architectural construction stage. This impact is not only limited to improving the efficiency of building construction but can also save a lot of labor costs in the construction process on the basis of ensuring the accuracy of building construction.

First, this article analyzes the performance of the existing architectural design information mining system in Figure 9a in various aspects. It can be seen that the existing architectural design information mining

systems perform relatively poorly in data collection and work efficiency, which is also a point where existing architectural design patterns need to be enhanced urgently. After analyzing the performance of the new architectural design information mining system in Figure 9b in four aspects, it can be clearly seen that this new architectural design information mining system has greatly improved in four aspects. From this, it can be determined that the performance of the new architectural design information mining system has increased by an average of about 25.9% compared to the existing architectural design information mining system.

7 Conclusion

The rapid development of social economy not only drives the progress of modern technology but also helps to achieve rapid development in multiple fields, which has made modern people's lives more convenient. The development of image processing technology and visualization technology in information technology has led to significant changes in the existing work steps of multiple industries, including medical, military, and construction industries. In particular, with the development of various information technologies, researchers in the field of architecture have attempted to incorporate visualization technology into the architectural design process, thereby promoting greater improvement in the efficiency and ultimate effect of architectural design. The visualization of architectural design not only helps various staffs deepen their understanding of architectural information and related knowledge but also enables in-depth analysis of relevant concepts of architectural design, thereby making the designed building more scientific and reasonable in structure. At the same time, the combination of the construction industry and visualization technology can also use the data analysis capabilities of visualization technology to collect data from multiple aspects of the design and construction process, thereby achieving the best in all aspects of building design. The visual design of a building can not only play a significant role in the design and construction of the overall structure of the building but also play a certain role in the design of its internal spatial combination, which can better meet the living needs of modern residents. This combination of architectural design and visualization technology not only meets the needs of modern social development to a certain extent, but also meets some of the requirements of people for living in the context of continuously improving quality of life.

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