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Article

Research on the role of biomechanical compatibility in the design of ceramic arts and crafts for tourism products

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Abstract: Ceramic art holds a significant position in China's traditional arts and crafts, with its materials demonstrating unique value across multiple fields. As the tourism industry continues to develop, there is an increasing demand for innovative, practical, and artistic tourism product designs. Modern designers study the biomechanical properties of ceramic materials, such as their stress response, processing characteristics, and usability, and combine them with their unique surface gloss and durability to transform them into visually appealing and functional products. This study introduces an enhanced Convolutional Neural Network (CNN) model for ceramic craft image recognition and structural optimization design. The research focuses on: 1) the enhancement of mechanical properties of ceramics combined with bioactive substances; and 2) the simulation of force distribution during ceramic manufacturing and the impact of craftsmen's hand-applied forces on shaping results. A parametric approach was employed to extract graphic elements from ceramic sketches, and simulation analysis was used to optimize material structural stability and stress distribution during use. Experiments show that the improved CNN model achieves over 95% accuracy in recognizing the visual features of ceramic products, effectively capturing product edge contours and identifying microscopic surface stress distribution. Furthermore, experiments on bio-ceramic materials confirmed their higher toughness and adaptability, with significant improvements in biomechanical performance, such as bending strength and contact force distribution. This study not only reveals the core role of biomechanical principles in the manufacturing and design of ceramic crafts but also provides an innovative framework for optimizing the artistic expression and mechanical performance of tourism products.

Keywords: ceramic materials; biomechanics; bioactive substances; crafts; mechanical compatibility; hand-applied force; tourism product design; CNN image recognition

1. Introduction

With the rapid development and prosperity of the tourism industry, the design of tourism products has experienced increasing market demand. Many tourist attractions produce specialized tourism products that are often rooted in traditional arts and crafts and are widely favored by tourists [1]. However, the integration of traditional arts and crafts with modern tourism products requires further optimization and promotion. As a higher education discipline, arts and crafts programs play a crucial role in training skilled professionals in design and production, supplying the growing tourism and handicraft markets with talented individuals [2]. Among these crafts, ceramic tourism products stand out due to their high ornamental and collectible value. Their diverse forms and relatively open production processes have secured ceramics a stable place in the increasingly popular tourism product market [3].

Advancements in ceramic production technology have not only preserved traditional manufacturing excellence but also amplified the artistic and aesthetic value of ceramics to an unprecedented level [4]. Modern technological innovations have freed ceramic production from past limitations imposed by rudimentary tools and lack of precision materials, enabling designers to focus on innovative, high-quality product designs [5]. As a cornerstone of China's traditional arts and crafts, ceramic art plays a significant role in cultural inheritance and economic impact. Therefore, integrating ceramics into local culture-based tourism product design is both culturally meaningful and commercially viable.

To improve the quality of ceramic production skills among arts and crafts students in art colleges and to meet the increasing demand for tourism products, it is essential to study the application of materials in ceramic production. Such research not only streamlines contemporary ceramic production stages but also explores new methodologies and materials to enhance craftsmanship. These efforts provide a theoretical basis for innovation in modern ceramic production [6].

In this context, computer image processing technology offers a powerful tool for analyzing and enhancing design. This technology encompasses preprocessing, segmentation, feature detection, and representation of image objects. Advanced analysis extends to classification, recognition, and content-based understanding of images [7,8]. This study proposes an optimized model for analyzing and designing the appearance of tourism products using an improved convolutional neural network (CNN). By focusing on the artistic expression of ceramic materials in arts and crafts specialties, the study aims to achieve optimal design for tourism product appearances rooted in ceramic materials.

As artifacts of history, ceramic products—manifesting in utensils and artistic forms—represent the pinnacle of China's traditional craft culture. These creations play an essential role in cultural preservation and transmission. However, the decline of traditional ceramic culture and the lack of successors in this craft present significant challenges. Addressing these challenges requires innovation. By combining the performance of modern ceramics with their unique surface aesthetics, designers can create fresh, elegant, and durable products that resonate with contemporary tastes [9,10]. Additionally, integrating elements of traditional arts and crafts into modern tourism products enhances their cultural richness and market appeal [11].

Keivanpour emphasizes that the technical stage of image processing should focus on analyzing and recognizing distinct image features while also delving deeply into the nature of images and the relationships between modeling elements and colors. This approach is essential for uncovering the meaning and focal points of image recognition, which can then guide and plan specific recognition actions [12]. A robust shape feature description is critical for image retrieval, requiring uniqueness, geometric invariance, and sensitivity to various attributes.

Building on these principles, Chen et al. used asymptotic learning to determine the required quantity of training samples and proposed a corresponding CNN structure. Their approach reduced algorithmic time complexity and enabled efficient defect detection in wood products [13]. Abidin et al. integrated CNN with the nonlinear mapping capability of radial basis function networks to construct a deep learning structure that mimicked human visual perception. By focusing on the attention areas identified, they mined the essential features of suspicious defect areas using a layer-by-layer convolutional network approach [14]. Wang et al. proposed combining geometric features in mechanical design images to create shape feature descriptors, improving the efficiency and accuracy of geometric feature analysis [15].

In the context of ceramics, Zhu et al. employed computer 3D modeling technology to achieve initial ceramic design modeling [16]. Anderson et al. advanced ceramic mold design by integrating rapid prototyping and reverse engineering technologies [17], while Liu et al. explored the feasibility and importance of digital technology in ceramic design [18]. Furthermore, Anderson et al. implemented a deep confidence network to identify defects in solar panel samples, combining training through initial weights and fine-tuning via backpropagation neural networks (BPNN). Their methodology used the contrast between reconstructed images and defect images for detection [19]. Wang et al. introduced an improved training method for GANs (Generative Adversarial Networks), ensuring that the discriminator’s feature maps for generated images closely resembled those of real images, which enhanced defect detection accuracy [20].

Despite the success of traditional image classification and detection algorithms in specific industrial contexts, these methods often rely on common pre-designed feature extractors and parameter optimization. Such approaches are less effective when addressing diverse industrial products and defect types. This study proposes an optimized CNN-based model for analyzing the appearance of tourism products. By prioritizing the rapid generation, transformation, and interaction of ceramic modeling, the model extracts graphic element information from ceramic product sketches through parametric methods. This enables the swift transformation of three-dimensional models for ceramic materials in tourism products, greatly enhancing the efficiency and precision of tourism product design.

Moreover, the study extends this approach by integrating biomechanical compatibility into the design process. By incorporating human-centered design principles such as ergonomic considerations and stress reduction strategies, the model aims to improve the usability and interaction between the user and ceramic tourism products. This interdisciplinary approach blends aesthetics, functionality, and biomechanical principles to create products that are not only visually appealing but also physically comfortable and mentally engaging for users.

2. Methodology

2.1. Integration design of traditional arts and crafts and ceramic materials tourism products

In the design of modern tourism products, integrating elements of traditional arts and crafts requires balancing aesthetics and practicality. Designers must interpret the value of arts and crafts through the lens of modern aesthetics to create products that cater to market demands while maintaining cultural significance. This involves embracing modern industrialization methods, such as informationnization, to enhance production efficiency and optimize the creative process. Ceramic materials, due to their unique requirements in manufacturing processes, demand design schemes that align with these processes to faithfully realize the designer's vision. As high-quality tourism products, ceramics should embody both aesthetic appeal and functional practicality [21].

In traditional arts and crafts design, manual production techniques should harmonize with contemporary aesthetic preferences. Designers should focus on embedding cultural and aesthetic values, producing refined tourism products that appeal to modern sensibilities. Incorporating popular elements in style, form, and taste enables tourism products to serve contemporary material and cultural needs while preserving ancient craftsmanship. Such products, grounded in cultural heritage, offer a meaningful bridge between tradition and modernity, meeting the evolving demands of the market.

Ceramic materials, predominantly sourced from the earth, offer versatility in their production processes, such as sculpting, fabricating, and firing. Their inherent environmental friendliness and compatibility with other materials allow for diverse applications. Techniques like overglaze decal paper can transfer intricate designs, including abstract compositions or photographic images, onto ceramic surfaces. Colored glazes, such as crystalline glazes, further expand creative possibilities by introducing unique textures, mineral effects, and vibrant color gradients that evoke a rich artistic ambiance [22].

The ultimate aim of designing ceramic tourism products is to promote national culture. Tourism products, as cultural artifacts, embody and extend cultural narratives through various material and artistic expressions. These products facilitate cultural exchange and dissemination, ensuring that traditional arts and crafts remain relevant in contemporary society. The cultural heritage embedded in ceramics, linked to painting, sculpture, and design, positions ceramic products as both artistic and functional items. Designers, through their reinterpretation of traditional culture, create products that resonate with modern consumers while preserving cultural authenticity.

The design process for ceramic tourism products is heavily influenced by the interplay of material, technology, and design thinking [23]. Material serves as the medium through which ideas take form, and technology determines how these ideas are realized. Image processing technology, for instance, transforms raw visual data into enhanced, structured formats, enabling accurate classification, detection, and recognition of design elements. This involves preprocessing steps like image enhancement, restoration, and compression, followed by segmentation and modular analysis. These techniques allow designers to identify unique features and characteristics, optimizing both storage efficiency and data transmission speed.

In the context of ceramics, image recognition technology enhances the design process by accurately identifying and classifying features of product sketches. This integration of technology not only streamlines the creative process but also ensures high precision in translating design concepts into physical products. By combining modern computational tools with traditional craftsmanship, ceramic tourism products can achieve a harmonious blend of cultural depth and contemporary appeal.

Biomechanical compatibility plays an integral role in enhancing the functionality and user experience of ceramic tourism products. By integrating human-centered design principles, such as ergonomic considerations and physical comfort, designers can create products that are not only aesthetically pleasing but also optimize user interaction and comfort. This holistic approach ensures that ceramic products meet both cultural and functional expectations, making them not only visually captivating but also practical and comfortable for modern consumers.

Ceramic material technology, as a resilient and versatile aesthetic medium, holds a dominant position in the tourism product market. Its ability to convey cultural narratives and evoke emotional resonance makes it a powerful tool in designing products with deep cultural heritage. By leveraging technological advancements in image processing and recognition, combined with biomechanics-based design strategies, designers can refine their approaches, creating ceramic tourism products that are rich in cultural and artistic significance while ensuring high usability and user satisfaction.

2.2. Image recognition model for appearance of ceramic materials tourism products

When ceramic materials are applied to products, the products will not be monotonous at all, and the products will be diversified. It can make people like ceramic products more and realize practical functions. Make the product have more cultural connotation, and the appreciation can also be displayed, which not only promotes the ceramic culture, but also makes the product value for money. Ceramic art can not only bring a lot of pattern creation to tourism products, but also carry out various forms of modeling innovation to tourism products, which can make the innovation of tourism products not stick to a corner. This is based on the designer's understanding of ceramic culture, so that tourism product innovation can be better created in the world and accepted by the public. The design stage of ceramic materials tourism products generally includes concept proposal, sketch drawing, detailed design and other processes. In the design process, ceramic craft products are usually revised repeatedly [24,25]. The neural network model of ceramic material tourism product design is shown in **Figure 1**.

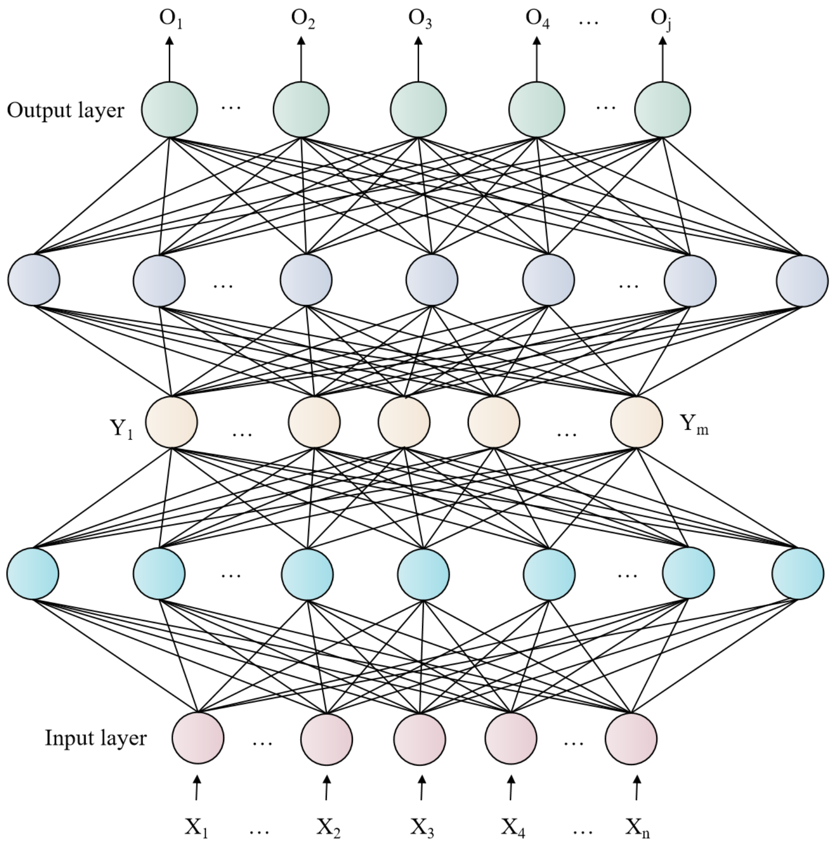

Figure 1. Neural network model of ceramic materials tourism product design.

Ceramic arts and crafts have historically emerged to meet the dual needs of material utility and spiritual enrichment. These works, deeply rooted in cultural and societal contexts, possess both high artistic value and strong practicality. Ceramic tourism products, in particular, reflect a profound cultural heritage, as ceramics are intrinsically tied to traditional arts such as painting, sculpture, and design. These products serve as a stage for re-creating cultural narratives through the unique interpretations of their creators, resulting in tourism products imbued with cultural attributes.

Ceramic tourism products carry the essence of national traditional crafts while embracing a broader cultural context. Modern creators, influenced by diverse cultural inputs, are no longer confined to traditional ways of thinking and expression. This liberation allows for a balance between tradition and innovation. Designers can explore the randomness and serendipity of decorative techniques, leaving traces of handwork that preserve the authenticity of the artistic process. Such characteristics enhance the cultural depth and individuality of ceramic tourism products.

2.2.1. Three-dimensional structure design in ceramic tourism products

The creation of ceramic tourism products often involves complex three-dimensional solid structures, which can be divided into smaller components for ease of modeling, assembly, and integration. The design process begins with a sketch that captures the outline information of the ceramic model. This sketch provides the foundation for extracting positional constraints between parts.

2.2.2. Profiles in ceramic modeling

Profiles, whether straight or curved, form the essential contours of ceramic designs.

Straight-Line Profiles: These are relatively simple to parameterize, as they involve straightforward geometric constraints.

Curved-Line Profiles: These require more intricate parameterization, including curvature, radius of curvature, and curvature center. The use of these parameters ensures precise representation and integration of the profile into the overall design.

By segmenting the structure into manageable components, designers can efficiently create detailed and cohesive three-dimensional models. These models not only enhance the visual appeal of ceramic tourism products but also improve the feasibility of their production processes. The profile curves, such as those shown in **Figure 2**, illustrate the complex interplay of form and functionality inherent in ceramic tourism product design.

This approach to design leverages both traditional craftsmanship and modern modeling techniques, ensuring that ceramic tourism products retain their cultural significance while meeting contemporary aesthetic and practical demands.

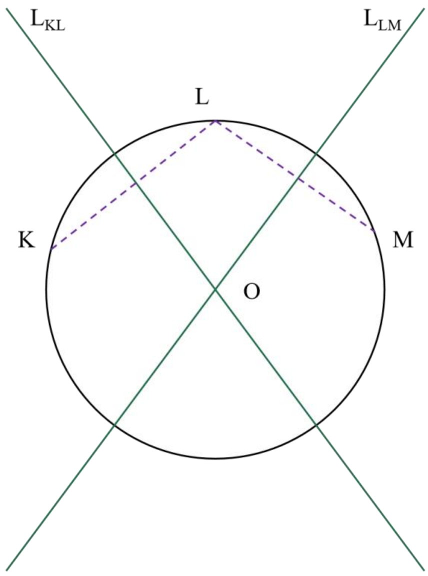

Figure 2. Profile curve of ceramic products.

While obtaining the feature map of the target to be detected, CNN eliminates the need for complex pre-processing of the image. By learning directly from training data, CNN bypasses the need for explicit feature extraction, allowing the model to automatically identify and optimize relevant features. This capability streamlines the process and enhances the efficiency and accuracy of image recognition.

The image recognition stage in the computer-aided design of ceramic materials for tourism products, based on CNN, involves multiple layers of processing to identify and analyze features such as contours, textures, and edges. As shown in **Figure 3**, the CNN-based framework processes raw input images, extracts hierarchical features, and generates feature maps that accurately represent the target characteristics of the ceramic product. This approach ensures high precision and reliability in detecting and modeling the visual attributes of ceramic materials, which is crucial for design optimization and artistic expression in tourism products.

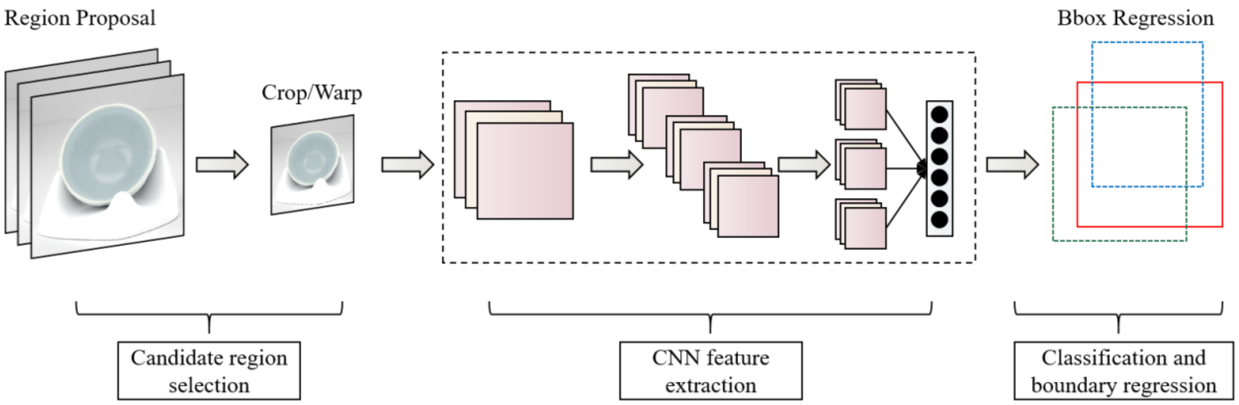

Figure 3. CNN model.

2.2.3. The generation stage of three-dimensional models in ceramic product design

The generation stage of a three-dimensional model of ceramic products follows a systematic process: extracting feature information from product sketch primitives, constructing model parts using a parametric primitive method, and completing the model through geometric rotation and splicing. When employing voxel enumeration representation for volume intersection techniques, the outer voxels surrounding the object are identified. These voxels are minute in size, and their centers are taken to create a discrete point set that outlines the entity. In this study, single-channel image data is acquired through image channel decomposition, followed by edge detection. The channel decomposition divides the image into blue, green, red, and transparent single-channel images. Each channel image is processed individually before being recombined into a full-color image.

The final product is a three-dimensional model, but minor misalignments often prevent perfect overlap of the spliced model entities. Additional adjustments are made by rotating the spliced parts around the feature points to achieve seamless and accurate assembly. Local modeling adjustments take advantage of parameterization, converting modeling requirements into parameter inputs for efficient and user-friendly modifications.

These local parameter adjustments allow specific parameter changes to fine-tune the model, achieving a high degree of precision in design. The quality of the created model relies not only on the overall product shape but also on the detailed features. For ceramic works of art, capturing and showcasing their unique characteristics is crucial for a successful model. Similarly, in molecular and cellular biomechanics, accurate representation of structural and functional features is essential for meaningful analyses. Just as biomechanics strives for the precise modeling of cellular structures to simulate biological processes, ceramic design demands high fidelity in capturing the texture, curvature, and surface details that reflect both aesthetic and functional aspects.

To ensure detail accuracy, a comprehensive modeling approach is adopted, emphasizing detail refinement. For example, the glazed surfaces of ceramics require smooth edges, making chamfering a necessary design step. These refinements ensure that the final model faithfully replicates the physical and aesthetic attributes of the ceramic artwork. In biomechanics, analogous care is taken in representing surface textures or structural details, as these influence the model's precision in simulating biological processes. Just as the biomechanics of cells and tissues requires attention to the smallest structural elements to ensure functional accuracy, ceramic models must faithfully reproduce texture, gloss, and smoothness for both artistic appeal and manufacturing precision.

During shape reconstruction, each captured image is segmented to extract the outline of the ceramic artwork. This segmentation is achieved by analyzing brightness and tone differences between the foreground and background. Such segmentation techniques align closely with those used in biomechanics to isolate cellular or molecular structures from complex backgrounds. By prioritizing detail perfection, the reconstructed models in both fields—ceramics and biomechanics—are better equipped to represent their respective physical and functional characteristics effectively. In both disciplines, the integration of precise modeling techniques ensures that the final product is not only aesthetically appealing but also functionally accurate and relevant to its intended application.

3. Result analysis and discussion

When collecting image data, if the brightness is too high or too low, the gray effect and gray values of the collected image may fall within a very narrow range, limiting the quality and usability of the image [26,27]. To address this issue, linear transformation processing can be applied. This involves linearly expanding the gray values of all pixel squares in the image using a linear single-valued function. This process effectively enhances the contrast of the image, improving its overall quality and imparting a more visually artistic appearance [28].

In modeling and optimization processes, the role of datasets is critical:

1) Test set: Used to evaluate the final performance of the model and verify its generalization ability. Importantly, the test set does not influence the parameter adjustment of the model.
2) Training set: This is the primary dataset used to fit the model and determine its parameters.
3) Validation set: Combined with the training set, it helps adjust model parameters to ensure improved performance.

Each iteration in the modeling process is assessed based on the feedback accuracy of the test set, and the iteration yielding the highest accuracy is retained. In experiments, several parameters are set to ensure consistency:

1) The optimization accuracy of each algorithm is fixed.
2) The maximum number of iterations is set at 300.
3) The population size for all algorithms is set to 15.
4) The dimension of all test functions is 32.

If the optimization error of an algorithm drops below 0.001, the iteration process is terminated.

These parameters ensure the balance between computational efficiency and model accuracy. The experimental results, presented in **Figure 4**, illustrate the optimization performance of different algorithms under the specified conditions. By adhering to these methods, the study achieves both effective image enhancement and robust model optimization, ensuring high-quality outputs suitable for applications such as molecular and cellular biomechanics or ceramic tourism product design.

In the context of biomechanics, accurate image enhancement plays a pivotal role in isolating biological structures, such as cells or tissues, from complex backgrounds. The same principles can be applied in the design of ceramic tourism products, where image processing ensures the precise identification of design elements, improving both the aesthetic and functional qualities of the products. In both fields, the integration of image processing with optimization algorithms ensures that the final product, whether it is for biological analysis or product design, is both visually compelling and highly accurate.

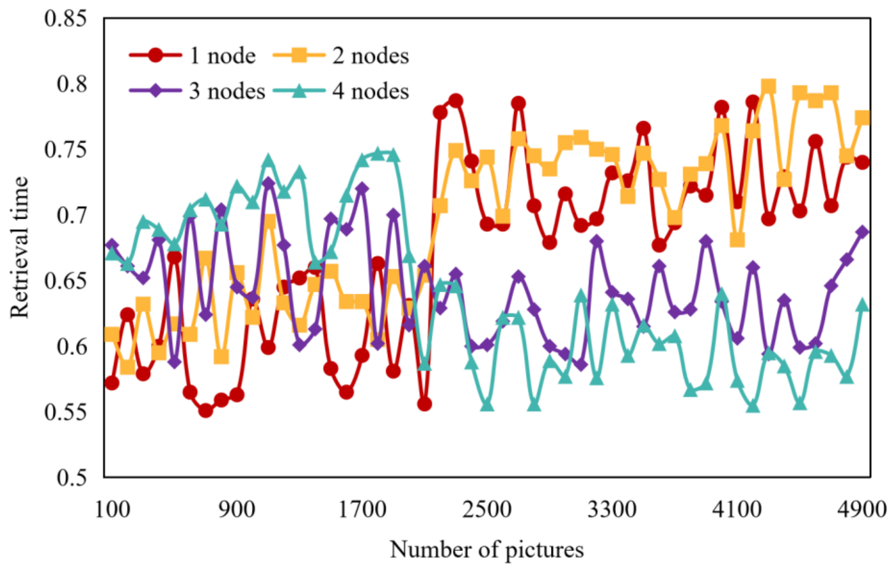

Figure 4. Image recognition consumes time.

Using digital image processing technology, the sensory information and experience are quantified and systematized as accurately as possible to obtain clear characteristics and laws, so as to improve the accuracy and reliability of image recognition of ceramic materials tourism products. Because different images have different image characteristics, this becomes the main basis for image extraction. To extract images successfully, it is need to strengthen the characteristics of image influence to improve the accuracy of interpretation.

The overall data of the training model and the performance of the ceramic product image optimization model are considered comprehensively. **Figure 5** shows the running time comparison results of improved CNN (Convolutional Neural Network) and SVM (Support Vector Machine) calculations.

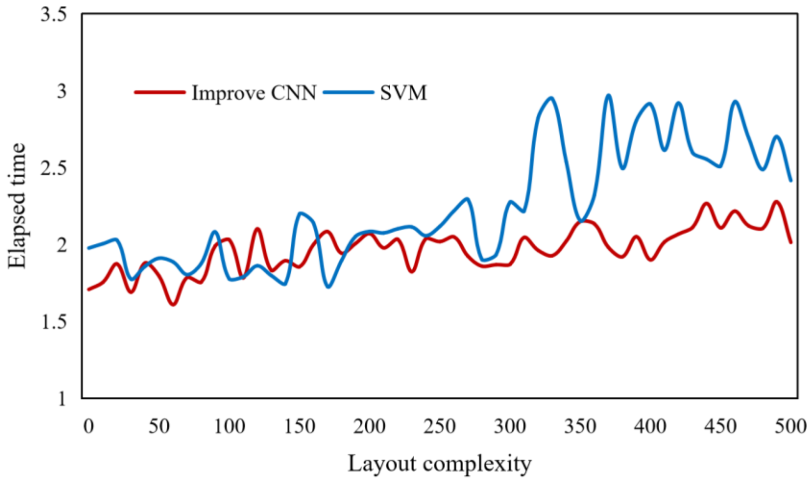

Figure 5. Calculation time comparison of algorithm.

It can be seen that although the improved CNN has no obvious advantages in the initial stage, when the complexity of the appearance images of ceramic materials tourism products is increasing, the improved CNN shows high operational efficiency. Compared with SVM algorithm, the improved CNN effectively improves the design efficiency because of its controllable execution parameters, clear objectives, less time consumption and lower similarity between structures.

Point cloud data obtained by comprehensive utilization of outer contour limitation and feature limitation. On the one hand, it is transformed into non-uniform spline description as modeling data after data fitting; On the other hand, the grid model described by VRML (Virtual Reality Modeling Language) can be directly output, which can be further modified and improved in other modeling software. **Figure 6** shows the MAE comparison results of the algorithm.

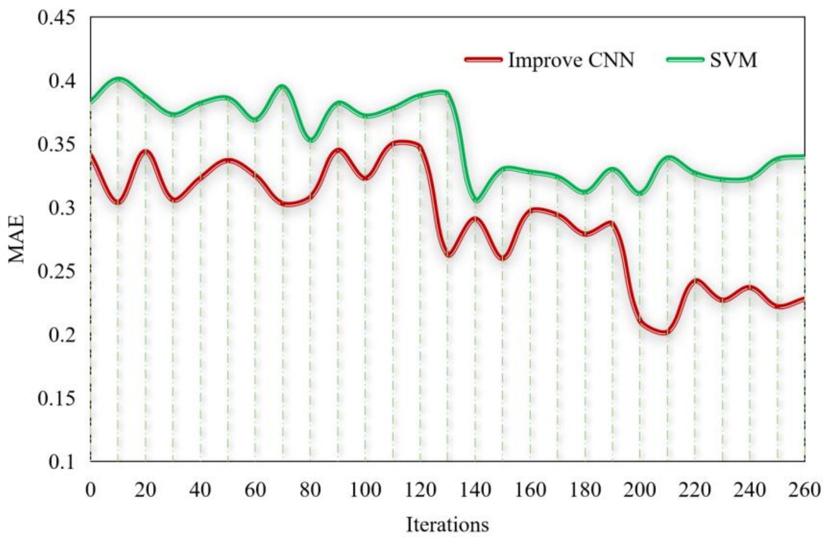

Figure 6. MAE comparison results of the algorithm.

Experiments show that the MAE (Mean Absolute Error) of the improved CNN model is significantly lower than that of the traditional SVM algorithm. In the context of molecular and cellular biomechanics, just as different ceramic artworks exhibit unique characteristics, biological structures at molecular and cellular levels also vary greatly. This means the modeling methods for such systems are not fixed and must be adapted based on the specific features of the structures being studied. Similarly, different modeling methods have their advantages and disadvantages, and in many cases, a combination of methods yields the most accurate results.

Effective image processing serves as the foundation for subsequent feature extraction and classification, directly influencing the detection resolution and recognition accuracy of the entire system. This is especially critical in biomechanics, where precision in identifying molecular or cellular features can affect the interpretation of biological functions and mechanisms. In ceramic tourism product design, accurate feature recognition allows for the precise representation of intricate patterns and textures, ensuring that products embody both artistic detail and functionality.

Compared to traditional optimization algorithms, the improved CNN offers several advantages, including a simpler calculation process, strong flexibility, suitability for parallel processing, robust performance, and the ability to handle complex nonlinear optimization problems. These features make it well-suited for addressing the intricate challenges presented by biomechanics data analysis, such as recognizing patterns in protein structures or cellular interactions. In the realm of ceramic tourism product design, the CNN model also enables accurate identification of surface textures and aesthetic patterns, making it an ideal tool for refining product design and optimizing its visual appeal.

The recall and accuracy of the feature recognition algorithm for product appearance images, as demonstrated in **Figures 7** and **8**, highlight the improved CNN's capability in identifying intricate patterns. This performance is not only applicable to ceramic tourism product design but also has significant potential in advancing the field of molecular and cellular biomechanics, where accurate modeling and recognition are essential for understanding biological phenomena. By applying this technology in both fields, we can achieve a harmonious integration of form and function, whether in biological studies or artistic product design.

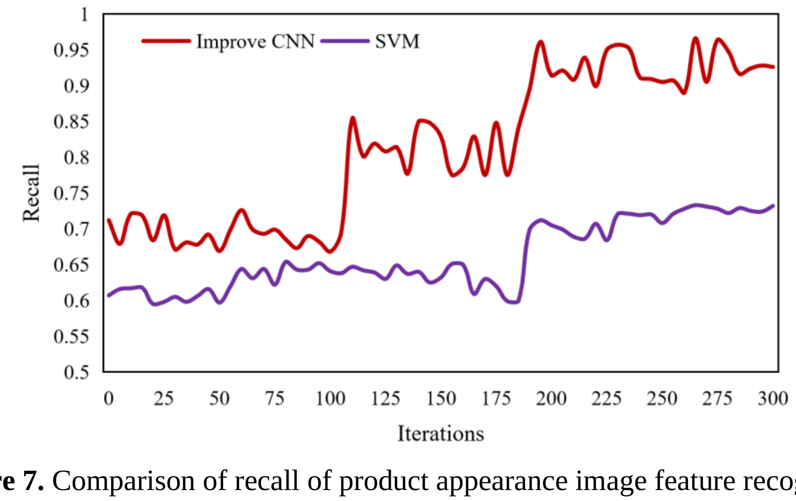

Figure 7. Comparison of recall of product appearance image feature recognition.

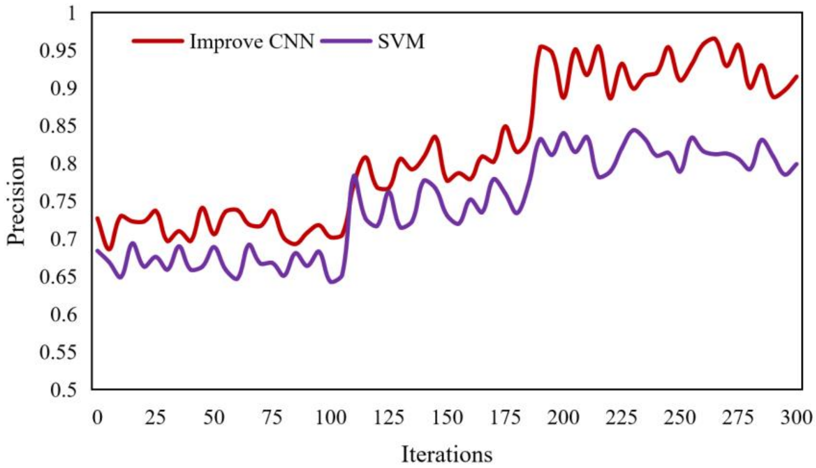

Figure 8. Comparison of feature recognition accuracy of product appearance image.

From the experimental data, it can be observed that, compared to the traditional SVM algorithm, the design accuracy of the appearance images of ceramic material products is significantly improved. The improved CNN demonstrates superior performance in identifying the features of product appearance images, achieving an accuracy of over 95%. This high level of precision enables the accurate localization of edge contours in the appearance images of ceramic material products, ensuring that even the most intricate design elements are faithfully represented.

In the context of molecular and cellular biomechanics, similar advantages of the improved CNN could be leveraged. For example, accurately identifying the boundaries of cellular structures or molecular configurations is crucial for biomechanical modeling and analysis. The enhanced edge detection capability of the CNN ensures that even complex and intricate biological features are correctly identified, enabling more precise simulations and improving the accuracy of biomechanical models. This capability not only enhances the understanding of biological structures but also provides critical support for diagnostic tools and medical applications, where precision is key.

By integrating advanced image processing techniques such as CNN-based edge detection in both ceramic design and biomechanics, we can achieve a seamless blend of form and function. Whether for identifying intricate surface textures in ceramic products or accurately delineating biological structures, this improved technology contributes to the precision, reliability, and effectiveness of both fields. This ensures high-quality outcomes in product design, medical diagnostics, and beyond, demonstrating the versatility and transformative potential of CNN-based image processing across disciplines.

4. Conclusions

Ceramic art holds a prominent place in China's traditional arts and crafts, with ceramic products being among the most influential. Designing tourism products grounded in local culture can effectively begin with ceramics. Leveraging three-dimensional parametric technology to design and create ceramic products while integrating computer aesthetics with product design offers immense potential. This study proposes an optimized model for the appearance image design of tourism products based on an improved CNN and analyzes the artistic expression of ceramic materials in tourism product design for arts and crafts majors. The goal is to achieve optimal design for tourism product appearances rooted in ceramic materials.

The experimental results indicate that the improved CNN is highly effective in identifying the features of product appearance images, achieving an accuracy rate exceeding 95%. This precision ensures accurate edge contour localization for ceramic material product appearance images. The advancements in 3D digital modeling technology have accelerated the intelligent development of the ceramic manufacturing industry, broadened the horizons of ceramic art design, and fostered the diversified growth of ceramic art design.

This study primarily focuses on the algorithm design and evaluation for ceramic material tourism products. However, the potential applications of this technology extend beyond product design. The integration of image recognition and advanced algorithms offers valuable insights for related fields, such as molecular and cellular biomechanics, where precision in identifying and classifying intricate biological structures is essential for accurate modeling and simulations. Similar techniques used to optimize ceramic product design can also enhance the accuracy of defect identification and feature extraction in biological models, such as protein structures or cellular interactions.

Future research can further explore the integration of visual surface characteristics with geometric features to conduct quantitative and targeted experiments. By combining aesthetics with biomechanical considerations, researchers could refine the design processes not only for ceramic products but also for biomechanical simulations. To enhance the accuracy and comprehensiveness of defect identification, future work could include storing diverse types of image feature information when building defect and feature databases. This approach would help address current limitations and ensure more robust defect identification and product optimization in both ceramic art design and related fields such as biomechanics.

Ethical approval: Not applicable.

Conflict of interest: The author declares no conflict of interest.

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