



## RESEARCH ARTICLE

# Application of Traditional Chinese Cultural Pattern Elements in Modern Interior Design Based on the Perspective of Computer Vision Technology

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Leveraging *state-of-the-art* Computer Vision (CV) innovations, the present article focuses on the artistic integration of traditional Chinese cultural patterns into modern interior design, addressing the imbalance between historical aesthetics and modern utility. Using Convolutional Neural Networks (CNN) optimized by Genetic Algorithms (GA), modern aesthetic demands are applied to traditional Chinese motifs, which possess deep significance as symbols and significance in history. Both the technical processes of recognizing and digitization of these complicated designs and the real-world implications of applying them to present-day interior design approaches are highlighted in this research project.

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**INTRODUCTION**

A recent development in Interior Design (ID) that perfectly balances historical aesthetics with contemporary utility is the flawless integration of cultural objects into fresh initiatives [1]. Using the advanced features of Computer Vision (CV) technologies, this work investigates how conventional Chinese Cultural Patterns (CCP) have been successfully implemented in modern ID. The oral tradition and metaphorical significance of the conventional CCP provide an environment for the intellectual and cultural transmission of numerous eras [2].

Numerous ancient CCP have deep figurative significance, such as blessings for durability, joy, or economic growth, and are consequently more than just ornamental [3]. The dynasties have

contributed their aesthetic touches and cultural significance to the preceding motifs, which have evolved over age [4]. For instance, a lotus flower symbolizes innocence, while dragons signify power and strength. The constant interaction between artwork and identity as a culture kept and transformed through centuries can be observed in the designs' durability and development through history [5].

New technologies have a significant influence on ID in contemporary situations, bringing up fresh possibilities for creative expression and practical use [6]. Architects today attempt to create places that appeal to individuals on an aesthetic and emotional level, and one method to do this is by combining modern utility with conventional values [7]. Incorporating and reworking conventional components to make these individuals relevant to modern lifestyles and fashion tastes has been revolutionized by the use of modern design software and technological devices [8].

With its robust pattern recognition and image processing features, computer vision technology is vital to this modern integration [9]. With the aid of these advancements, architects can digitally maintain and change historical patterns with incredible precision and performance, and they may also perform accurate analyses and copies of complex designs. These trends can be accurately classified and converted into electronic files that fulfill the requirements of modern architecture with the help of Machine Learning (ML) algorithms like Convolutional Neural Networks (CNNs) [10].

This is the framework for the research we are conducting, which demonstrates an innovative method using a Convolutional Neural Network Model tuned by Genetic Algorithms (GA) for Transfer Learning. The goal of this framework is to properly integrate traditional CCP into modern interior design ideas by recognizing and categorizing them [11, 12]. By combining the application of cutting-edge artificial intelligence (AI) with the significant historical significance associated with conventional designs, the initiative aspires to design lovely, historically vital living areas.

To achieve visually appealing and pertinent designs, CNNs are employed for accurate pattern recognition and evaluation, and GAs are implemented to optimize design choices and implementation. The combined use of these technologies facilitates a novel method of design that respects and revitalizes cultural heritage through modern ID practices. The implications of this technology-driven approach are profound, offering new avenues for designers to merge historical aesthetics with modern functionality [13-15]. By documenting the processes and outcomes of this integrative approach through detailed case studies, this paper aims to contribute to the academic and professional fields of ID and architectural technology, providing insights into the sustainable preservation of cultural heritage within contemporary design frameworks.

Based on the introduction of the above content, this study mainly analyzes the application of traditional Chinese culture in the design process with the focus on visual communication technology. The paper is organized as follows: Section 2 describes the methods used in this work, Section 3 describes the methods, section 4 presents the case studies, and Section 5 summarizes the work.

## 2.0 METHODS

### 2.1 CNN

CNN is a class of Deep Neural Networks (DNN) that is highly effective in image analysis and pattern recognition tasks, making it ideal for identifying and categorizing complex designs such as traditional CCP in modern ID applications. A CNN typically consists of several layers performing specific functions to process and understand image data.

- **Input Layer:** The input layer of a CNN directly receives the raw image data. For our application, this involves digitized images of traditional CCP or contemporary design elements. In order to sustain coherence over the data set, these images are usually pre-processed to be identical in size and dimension.

- **Convolutional Layers:** Feature maps originate through the application of different filters to the input data by the CNN's core, the convolutional layers. Essential features like boundaries, shapes, and patterns have been identified automatically by these types of filters. Sliding these filters across the image and determining the dot product at every point is what the convolution operation is really about. In a convolutional layer, this operation's formula corresponds to this:
  - $S(i, j) = (I * K)(i, j),$  (1)
  - where  $I$  is the input image,  $K$  represents a kernel (filter), and  $S$  is the feature map produced.
- **Activation Function:** To add the non-linear to the approach, an activation function such as the Rectified Linear Unit (ReLU) is applied following the convolution step. The ReLU function is defined as:

$$f(x) = \max(0, x), \quad (2)$$

which retains only positive values and sets all negative values to '0'. The network can process complex patterns with greater effectiveness after this phase.

- **Pooling Layers:** Using pooling layers, the number of dimensions of each feature map decreases without missing all of the essential data. Increasing the utilization of the feature map's patches is a prevalent method called max pooling. To minimize the output size and allow the network to zero in on a few essential features, a 2x2 pooling functioning, for example, selects the highest score from each 2x2 matrix segment of the feature map.
- **Fully Connected (FC) Layers:** In the last phase of a CNN, there is at least one FC layer, which links all of the layers to the data from the preceding layer. Data flattening and preprocessing for the end classification or regression task are frequently used for these layers. The last stage of the network called the output layer, is accountable for producing a final prediction based on the features that the neural network has extracted. This prediction could be everything from identifying patterns to classifying elements of design.

## 2.2 Genetic Algorithms (GA)

The evolutionary theories of DNA and natural selection are the basis for GA, which are adaptable heuristic search algorithms. In cases where traditional methods have not worked, they excel in efficiency and search. GAs are appropriate for introducing conventional CCP to modern ID environments because of their frequent usage in visual arts and fashion.

- **Initialization:** A collection of options is first generated at random in GA. A solution, sometimes called a gene or a human being, is a feasible design adaptation that combines contemporary components with traditional patterns. In the realm of design, the DNA strands could stand in for numerous components, and their configurations encoded as sequences of genes.
- **Fitness Function:** Importantly, the fitness function evaluates how every approach meets its design objectives. Aesthetic appeal, historical authenticity, and compatibility with contemporary design principles are some of the established standards used for allocating a fitness score to each gene by the function it serves. Mathematically, the fitness function can be represented as ' $f(x)$ ', where ' $x$ ' is a chromosome, and ' $f(x)$ ' provides a quantitative measure of its suitability.
- **Selection:** The process of evolution is comparable to the process of natural selection in that it provides an advantage for children of better parents. It is typical to use techniques for selection, such as choosing a tournament or roulette wheel selection. In roulette wheel selection, for example, every person's probability of being selected is proportional to its fitness, which is set by

$$P(x) = \frac{f(x)}{\sum f(x)} \quad (3)$$

where  $P(x)$  is the probability of selection.

- **Crossover:** A genetic function referred to as crossover or recombination can be used to generate children by merging the DNA of two parents. The ideal situation would be for a new generation to model themselves after both parents regarding desirable traits. The single-point crossover is the most basic crossover; in this type of crossover, genetic data is transferred between two living things by choosing a random point on their DNA sequences.
- **Mutation:** Mutation improves the starting point of a DNA chromosome by altering the value of any number of genes, thus introducing randomness to the population. To avoid local minima, genetic variation is made available, and the algorithm is permitted to discover an additional search space. The mutation can be represented as a random alteration of a gene ' $g$ ' in a chromosome ' $x$ '.

$$\text{where } g' = \text{mutate}(g) \quad (4)$$

- **Termination:** When a requirement is satisfied—a maximum number of generations of people, a suitable fitness level, or a decrease in fitness levels—the algorithm ends functioning. The two subsequent results are far more probable than the first.

### 3.0 METHODOLOGY

#### 3.1 Data Collection: Sources of Traditional Patterns and Modern Design Elements

Combining classic CCP with modern ID demands thorough data collecting from historical archives and current fashion trends. Objects of art, textiles, and clothing in China preserved in renowned art galleries, like Beijing's Palace Museum, act as the primary source for traditional designs. In order to conduct a comprehensive analysis of patterns, it is essential to collect these objects using excellent-quality imaging methods that record complex designs down to the most minor elements.

Additionally, features of contemporary design have been selected from widely-read ID platforms and fashion publications. The extraction of data is done using modern digitization tools after electronically obtaining these sources of information. In order to help with further investigation, this method provides an extensive database of present ID visuals and concepts.

A hierarchical library serves to digitally store and classify the data collected from contemporary and historical sources. This renders it simple to access and analyze the data. For image processing, this database of data employs the use of CV tools like OpenCV, which enable rapid identification of patterns and texture matching. By integrating these resources, we can create ID solutions that are both creative and maintaining with historical traditions and current trends, with a perfect balance of old and new. You can find a list of all the data types used in the work, along with links to where you can find information on the internet, in Table 1.

**Table 1: Data source**

Data Type	Source	Description
Historical Pattern Images	Palace Museum, Beijing	High-resolution images of traditional CCP from ceramics and textiles.
Contemporary Design Images	Design Magazines (e.g., ArchDaily)	Modern interior design trends and concepts from various contemporary projects.

<b>Pattern Books</b>	University Libraries (JSTOR)	Scanned images and text from historical pattern books documenting traditional motifs.
<b>Design Software Elements</b>	Autodesk Revit, SketchUp	Digital design elements from ID software libraries.
<b>Social Media Content</b>	Pinterest, Instagram	User-shared contemporary designs and innovative decoration ideas.
<b>Online Cultural Databases</b>	Digital Silk Road Project	Digitalized traditional patterns are available for educational and preservation purposes.

### 3.2 Proposed Pattern Recognition Model Based on GA-Optimized Transfer CNN Model

The proposed approach leverages a specific use of an optimized Transfer Learning-based Convolutional Neural Network (Transfer-CNN) to recognize and integrate historical CCP into modern ID. The ResNet-50 network was initially trained on the ImageNet sample; this algorithm requires the use of its framework and training findings to adapt the network to the specific task of recognizing and categorizing complicated conventional trends in contemporary design environments.

#### 3.2.1 Transfer Learning-based Convolutional Neural Network (Transfer CNN)

- **Model Configuration:** A Deep Residual Network (DRN) with a track record for successfully tackling vanishing gradients, the ResNet-50 model is employed by the Transfer CNN. This makes it possible to learn using several layered convolutions without compromising efficiency. The model uses the weights from ResNet-50 pre-trained on the ImageNet dataset as its initial state, providing a strong feature recognition base.

#### Parameter Settings and Adaptation:

- **Learning Rate:** Set at 0.0001 to fine-tune the model subtly without disrupting the pre-learned features.
- **Loss Function:** The model utilizes cross-entropy loss, specifically computed for multi-class classification tasks in pattern recognition. The loss function is detailed as
- $$L = -\sum_{c=1}^M y_{o,c} \log(p_{o,c}), \quad (5)$$
- where  $M$  is the number of classes (patterns),  $y$  is the binary indicator ( 0 or 1 ) if class label  $c$  is the correct classification for observation  $o$ , and  $p$  is the predicted probability of observation  $o$  being of class  $c$ .
- **Optimizer:** The Adam optimizer is employed with its default parameter settings (  $\beta_1 = 0.9, \beta_2 = 0.999, \varepsilon = 1e - 08$  ) to ensure efficient and effective minimization of the loss function.

#### 3.2.2 GA Optimization

The GA specifically optimizes key architectural elements of the ResNet-50 model, such as the number of layers that are actively learning (depth of fine-tuning) and the dropout rates in the fully connected layers, to prevent overfitting while maintaining a balance between accuracy and model complexity.

#### GA Operations:

- **Population Initialization:** Each individual in the GA population represents a unique configuration of the ResNet-50 model where parameters like depth of fine-tuning and dropout rates are varied.

- **Fitness Evaluation:** The fitness function is defined as

$$f(x) = \text{Accuracy}(x) - 0.01 \times \text{Parameters}(x), \quad (6)$$

- prioritizing models that achieve high accuracy while using fewer parameters to maintain computational efficiency.
- **Selection and Reproduction:** The tournament selection method is used to select the best-performing models, which are then crossed over and mutated to generate new model variants.
- **Mutation:** Mutation occurs at a low probability (*e.g.*, 1%), introducing slight variations in the model configurations to explore potentially beneficial alterations in the network architecture.
- The top-performing configurations from the GA optimization process are aggregated into an ensemble model. This model averages the predictions from each selected variant of ResNet-50, enhancing prediction stability and accuracy across diverse design scenarios. The following algorithm details the proposed model.

**Algorithm 1:** GA-Optimized Transfer CNN Model Using ResNet-50

*Inputs:*

1. **Pre-trained Model:** ResNet-50 model with weights initialized from ImageNet.
2. **Dataset:** Collection of images featuring traditional CCP and modern ID elements.
3. **Parameters:**
  - Learning Rate (LR): 0.0001
  - Optimizer: Adam ( $\beta_1=0.9$ ,  $\beta_2=0.999$ ,  $\epsilon=1e-08$ )
  - Loss Function: Multi-class cross-entropy

*Outputs:*

1. **Optimized Model:** The trained ResNet-50 model was adapted to recognize and integrate traditional patterns into modern designs.
2. **Performance Metrics:** Accuracy, Precision, Recall, and F1-score on the test dataset.

*Process:*

1. **Initialization:**
  - Load the pre-trained ResNet-50 model.
  - Prepare and preprocess the dataset: Resize images to 224x224 pixels and apply normalization.
2. **Model Configuration:**
  - Configure the trainable layers of ResNet-50 based on initial chromosome settings from GA (depth of fine-tuning and dropout rates).
3. **Training Phase:**
  - Train the model on the training set using the configured parameters.
  - Evaluate the model on the validation set.
  - Calculate loss using the cross-entropy function and adjust weights with the Adam optimizer.
4. **GA Optimization:**

- **Population Initialization:** Generate an initial population where each individual represents a set of configurations for the ResNet-50 model.
  - **Fitness Evaluation:** Assess each individual using the validation set, where fitness is determined by the accuracy of pattern recognition minus a penalty for complexity (to prevent overfitting).
  - **Selection:** Apply tournament selection to choose the fittest models for reproduction.
  - **Crossover and Mutation:** Perform crossover and mutation operations to generate new individuals, introducing diversity.
  - **Replacement:** Replace the less-fit models with new, potentially superior ones.
5. **Final Model Selection:**
- After several generations, select the top-performing model configuration based on the GA.
  - Re-train the final model configuration on the entire training set to fine-tune and adjust parameters.

### 3.3 Integrating Selected Patterns into Interior Design Software

Integrating optimized traditional CCP into modern ID software involves a sophisticated process tailored to enhance usability and design flexibility. The easy incorporation of these patterns into ID's designs ensures both aesthetically pleasing qualities and historical awareness. Autodesk Revit and SketchUp were selected as the ID systems for the integration because of their substantial feature sets and acceptance in the manufacturing sector. The digital transformation of each design into high-resolution images or vector files enables quality maintenance across different scales and tricks, making application development for conventional designs significantly simpler. To help architects make intelligent choices, these digital assets have data highlighting their long history, common uses, and preferred scaling ratios.

In order to simplify the task of embedding designs, an add-on has been developed specially for each design software. The possibility to import, modify, and integrate the designs directly into layout designs is made feasible by this add-on. It includes functions that enable users to modify the size, the initial phase, and the color of the design depending on the task's specifications. The scaling of each pattern is determined algorithmically, using the expression  $S = \sqrt{\frac{A_d}{A_p}}$  to calculate the optimal scale based on the area it needs to cover, where ' $S$ ' represents the scaling factor, ' $A_d$ ' is the area of the design surface, and ' $A_p$ ' is the original area of the pattern.

Remodeling the designs in real-time is rendered feasible by the plugin's adaptive customization tools, which consist of dynamic sliders and fields. Designers can adjust parameters such as rotation, represented by  $R(\theta)$  where  $\theta$  is the angle, opacity ( $\alpha$ ), and color transformations ( $C$ ), enhancing the flexibility in design customization.

The tool includes built-in templates featuring classic patterns that render creating designs even simpler. Easily customize these predefined designs to what you want by selecting from any number of categories of rooms and design choices. To adapt designs for client preferences or specifics of the project, designers have the choice to modify integrated designs or add fresh designs from the pattern library.

Following these designs are comprehensive training materials and data that can be used for scientific and artistic purposes. To more fully comprehend the cultural context of the patterns and make the most of the new tools, the following resources have been provided. At its beginning, we set up an assistance program intended for designers to assist people with any artistic or technical problems that come up so they can use classic CCP to its maximum potential when developing contemporary ID works.

#### 4.0 Case Studies: Implementation of Technology in ID Projects

The section explores two detailed case studies of ID tasks that highlighted how the combination of conventional CCP alongside modern computer vision technology and ID technology substantially enhanced the design results.

##### 4.1 Case Study 1: Boutique Hotel Lobby Redesign, Shanghai

**Project Description:** The intention of the City of Shanghai premium hotel's lobby renovation is to impart an atmosphere of contemporary design while still paying attention to the region's cultural heritage. The objective was to render it comfortable while combining cutting-edge features based on conventional CCP features.

###### i. Design Challenges:

- **Balancing Tradition and Modernity:** The most challenging challenge was identifying an approach for implementing historical CCP that wasn't competing with the modern designs of furniture and equipment.
- **Spatial Constraints:** As a result of the small size of the lobby, thoughtful design was needed to include designs that would capture attention without restricting the area.

**ii. Implementation:** Designers researched the era of the Qing Dynasty to find their magnificent and detailed designs, which they retrieved and subsequently modified using an individualized SketchUp tool. The selected patterns were digitally adjusted for scale and color to match the lobby's color scheme and lighting. Patterns were applied to key focal points, including the front desk backdrop and floor tiles, using the scaling expression to ensure that the design fits perfectly within the physical dimensions of the lobby. **The designers' in-depth study of the Qing Dynasty did not stop there. They dug deep into the cultural essence of the era, drew inspiration from it, and cleverly incorporated it into modern design. They noticed the furniture design of the Qing Dynasty, with its smooth lines, fine carvings and full of Oriental charm. As a result, the designers cleverly integrated these elements into the furniture design of the hall, making the entire space full of classical and modern interwoven harmony. In addition to the furniture design, the designers also cleverly integrated architectural elements from the Qing Dynasty into the spatial layout of the hall. They refer to the symmetrical layout and hierarchical spatial structure of the Qing Dynasty palace, which makes the space of the hall more open, but also enhances the sense of layer and depth of the space. In the lighting design, designers also fully draw on the Qing Dynasty lighting methods. They used classical lanterns and chandeliers, combined with modern lighting technology, so that the lighting of the entire hall has both a classical charm and meet the needs of modern lighting. At night, these lighting devices emit soft and warm light, making the whole hall more warm and comfortable. Finally, the designers also considered the practicality and functionality of the hall. According to the use of the hall and the flow of people, they reasonably planned the passage and seating area to ensure the convenience and comfort of people's movement. At the same time, they also equipped the hall with advanced audio equipment and multimedia systems, so that the hall can hold a variety of activities and meetings to meet the diverse needs of people.**



iii.**Outcome:** The redesigned lobby (Fig. 1 (a) to (c)) successfully merged the traditional and modern elements, creating a unique and inviting space. Feedback from guests highlighted the seamless integration of cultural depth, praising the thoughtful incorporation of traditional motifs that added a distinct character to the hotel's modern setting.



**Figure 1 (a) to (c): Redesigned lobby of boutique hotel shown from different angles**

#### 4.2 Case Study 2: Residential Apartment Complex, Beijing

**Project Description:** The project involved designing the interior of a new residential apartment complex in Beijing, aiming to attract young professionals who appreciate a blend of cultural heritage and modern design.

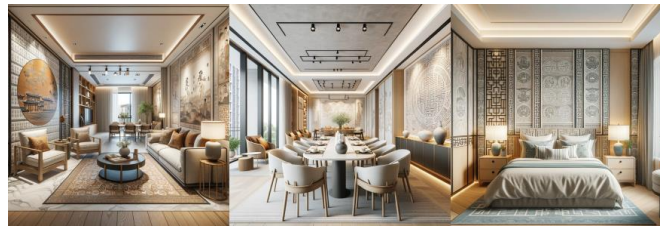
##### i.Design Challenges:

- **Diverse Preferences:** Catering to a demographic with varied tastes required a versatile design approach that could universally appeal to all residents while emphasizing cultural significance.
- **Incorporating Technology:** Implementing the newly developed ID software and ensuring that the traditional patterns were adapted accurately and effectively posed a technical challenge.

**ii.Implementation:** Designers utilized Autodesk Revit to incorporate traditional CCP into the living spaces of the apartments (Fig. 2 (a) to c)). They chose patterns from the Han Dynasty, renowned for their symbolic meanings and aesthetic appeal. These patterns were incorporated into the wallpapers, upholstery, and glass partitions. Adjustments to the pattern's opacity, color, and scale were meticulously managed through the developed plugin, with particular attention to maintaining the integrity of the patterns across various textures and materials. **The designers are not limited to the application of traditional patterns, but also explore new ways to combine these elements with modern design principles. They use modern materials and processes such as glass, metal and LED lighting to breathe new life into traditional patterns. For example, in the living room design of the apartment, the designers used glass partitions with Han Dynasty patterns, combined with metallic furniture and modern art decorations, to create an atmosphere that is both traditional and modern. In the bedroom design, the designers used soft colors and materials, combined with Han Dynasty wallpaper patterns, to create a warm and comfortable sleeping environment. These wallpapers are not only decorative, but also incorporate modern printing techniques to ensure the clarity of the pattern and the durability of the color. In addition, the designers also considered the practicality and functionality of the apartments. They planned the layout of the space to ensure that each room had plenty of light and ventilation. At the same time, they also designed convenient storage systems and smart home systems to provide residents with a more convenient and comfortable living experience. With its unique interior design, the residential apartment complex has successfully attracted the attention and affection of a large number of young professionals. Residents have praised the blend of traditional and modern elements in the designs, praising them as not only aesthetically pleasing, but also full of cultural**

significance. The rental rate of the apartment has increased rapidly, becoming one of the most high-profile residential projects on the Beijing market.

iii. **Outcome:** The project was acclaimed, particularly for its innovative use of traditional elements in a modern context. The residents appreciated the subtle touches of heritage, which provided a sense of continuity and identity. The use of cutting-edge software enabled precise and aesthetically pleasing implementations, demonstrating the effective integration of technology in modern ID. Adopting cutting-edge applications enabled precise and visually appealing deployments, demonstrating how innovation has been successfully incorporated into the current ID.



(a)

(b)

(c)

**Fig. 2: Designing the interior of a) Hall, b) dining hall, and c) Bedroom**

#### 4.3 Reactions from the Design Community and End-Users

Using a methodical approach involving questionnaires, interviews, and qualitative research, researchers could precisely determine the opinions of both the development industry and users for both case studies. Owing to this approach, we collected specific feedback on every component of the design's application.

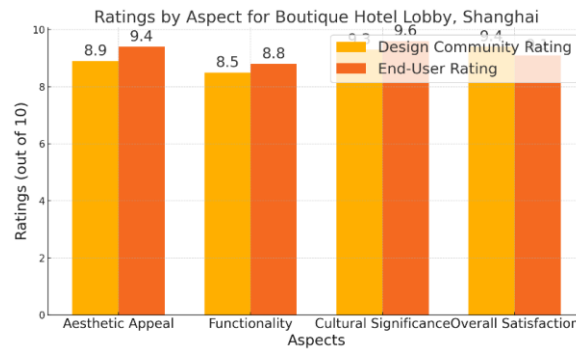
##### i. Case Study 1: Boutique Hotel Lobby, Shanghai Methodology:

- **Surveys:** After remodeling, personalized questionnaires were sent to customers and hotel employees. Topics measuring things like simplicity, aesthetically pleasing qualities, and significance in culture have been included in these questionnaires using Likert scales.
- **Interviews:** The hotel's expert review of its ID inclusion was the main objective of deep discussions with a selected group of designers who completed the visit.
- **Observational Studies:** Guests' relationships with the remodeled facilities and any comments without being asked were the focus of a month-long qualitative investigation in the lobbying effort, throughout which the study's team collected information.

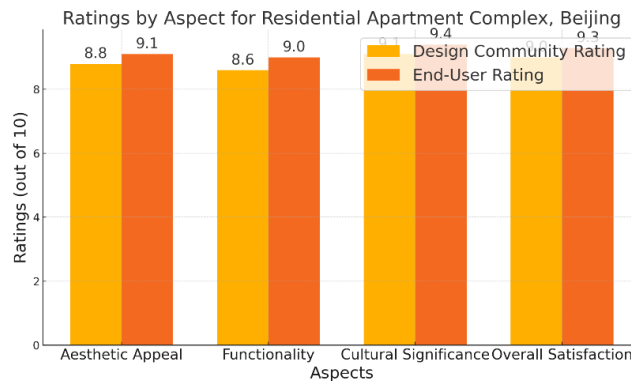
##### ii. Case Study 2: Residential Apartment Complex, Beijing Methodology:

- **Surveys:** Internet-based polls have been sent out to homeowners to assess the level of happiness with the ID and determine whether the designs impacted how households viewed their living areas.
- **Interviews:** Members of the work, comprising residents and interior designers, were allowed to express their opinions on the utility and emotional impact of the traditional designs during regular reviews.
- **Observational Studies:** Throughout social occasions in the intricate, investigators collected informal input and connected with residents to observe their reactions to used rooms with merged designs.

### 4.3.1 Reactions from the Design Community and End-Users



**Figure 3: Reaction for Boutique Hotel Lobby, Shanghai**



**Figure 4: Reaction for Residential Apartment Complex, Beijing**

### 4.3.2 Discussion of Reactions from Design Community and End-Users

Organized polls, interviews, and qualitative research were employed to collect input from the design group and end-users. The two instances studied, an apartment complex in The city of Beijing and a small hotel lobby in the Chinese City of Shanghai, demonstrate the successful integration of conventional CCP into modern ID. In the following section, researchers explore the specific emotions and perceptions the studies developed.

#### *i.Shanghai Boutique Hotel Lobby*

- Design Community Reactions:** People who know about design were captivated by the Shanghai premium hotel lobby's elegant fusion of historic CCP and modern ID features. The high rating in aesthetically pleasing is an indication of how much individuals value the achieved refined, harmonious appearance. In order to maximize the space's narrative as much as possible, the designers highlighted conventional designs that act as both decoration and elements of narrative, as well as creative space usage. While the performance ratings were slightly lower than expected, they were still positive, showing that the design could function effectively even in a highly populated location. Employing designs from the times of the Qing Dynasty was regarded as historically significant because it made the hotel appear more genuine aesthetically and provided guests with an enjoyable stay. **Guests highly appreciated the renovation of the lobby. Many people have mentioned that the first impression when entering the lobby is its unique decor, which makes them**

feel that they are stepping into a space full of history and culture. The results of the survey showed that most guests found the lobby design to be both beautiful and functional, providing a comfortable resting and waiting area. At the same time, they also appreciated the hotel's respect and inheritance of traditional culture, which is a good cultural experience. In the interview, some guests shared their memorable experiences in the hotel lobby, such as admiring the decorative details with family or friends, taking photos, etc. These experiences not only enhanced their stay, but also gave them a deeper emotional connection to the hotel.

- **End-User Reactions:** Excellent scores on aesthetic value and general satisfaction were among the positive feedback left by hotel guests. Visitors were delighted by the multicultural environment, making the hotel stand out and their stay even better. Tourists demonstrated an abundance of curiosity about the design elements, demonstrated by the qualitative research that revealed them paying attention to the particulars and some asking questions about the origins of the designs.
- *Beijing Residential Apartment Complex*
- **Design Community Reactions:** The modern-day apartments' perfect integration of Chinese architectural designs delighted those who were architects and design professionals involved in the home design process. In order to draw in young adults looking for an urban dwelling that is also historically anchored, respondents emphasized the significance of conventional designs' versatility when integrated with contemporary amenities. This adaptability is reflected in its practical result, which emphasizes that the design supports contemporary lifestyles while maintaining historical information. **The designers praised the interior design of the apartment complex, saying that it successfully combines traditional elements with modern design principles to create a living environment that is both beautiful and functional. They particularly appreciated the designer's attention to detail, such as the careful application of Han Dynasty motifs in wallpapers, upholstery and glass partitions, as well as the careful matching of colors and materials.**
- **End-User Reactions:** The designs were valued by the apartment building tenants for increasing the social significance and visually appealing qualities of their living areas. Several claimed they experienced more connection to their cultural heritage, which they valued because it had become integral to who they were. Homeowners appreciated the planned layout, which allowed privacy while allowing for simple interaction due to the appropriate conventional designs that encouraged discussions.

Knowing that both example studies' respondents had no complaints shows that the initiatives were effective in meeting and sometimes exceeding their goals. The respect received from the ID profession for the works' creative concepts and the joy experienced by the end users are proof of the perfect balance of new and old.

## 5.0 CONCLUSION AND FUTURE WORK

Applying cutting-edge Computer Vision (CV) methods like CNNs improved by Genetic Algorithms (GA), this research demonstrates the successful integration of traditional Chinese Cultural Patterns (CCP) into modern interior design (ID). A domestic apartment building in the city of Beijing and a boutique hotel lobby in the city of Shanghai provide illustrations that highlight how these advances can be employed to build places that peacefully integrate modern utility with historical aesthetics. People and members of the design industry provided overwhelmingly favourable reviews, complimenting the culturally aware designs' aesthetically pleasing and psychological resonance. People admired the conventional symbols' capacity to give residents a sense of permanence, while

designers praised the creative application of technology to maintain cultural integrity while guaranteeing modern relevance.

In the future, this investigation will provide novel avenues for technological advances and personalized design alternatives that incorporate artistic heritage across various design environments. The investigation's beneficial outcomes highlight the likelihood of improving modern ID environments by retaining historical significance by using advanced technology in a method that supports heritage while adopting technology.

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