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Visual Communication Style Analysis Combined with Computer Learning and Ceramic Packaging Design Innovation

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Abstract

The packaging is referred to as a ceramic package since ceramics are employed as part of the material for each of these components. Innovative product package design specializes in providing economic advantages by increasing sales of the product and enhancing the brand's reputation. From ceramic packaging to plastic packaging, the obstacles are larger and heavier. Cost increases may result from the production and testing of ceramic packaging. In this study, we proposed a novel spiral-optimized adjustable XGBoost (SO-AXGBoost) to analyze the ceramic packaging design. In this study, we collected a large dataset of images featuring various ceramic packaging designs. The features were extracted from images of packages using discrete wavelet transform (DWT). The outcomes demonstrated that while before optimization can evaluate ceramic package design, after-optimization outperformed the others in terms of assessing package design. The study demonstrates that effective techniques for learning ceramic package design can be combined with visual communication style analysis. This creative approach improves market trends and customer preferences in addition to the practical and aesthetic features of packaging.

Keywords: *Visual Communication Style, Ceramic, Package Design, Spiral Optimized Adjustable Xgboost (SO-Axgboost).*

INTRODUCTION

Visual communication style evaluation includes inspecting and understanding the diverse elements and principles that contribute to how visual messages are perceived and interpreted. This field encompasses a number of disciplines, together with image layout, advertising and marketing, and multimedia, and employs techniques from psychology, semiotics, and cultural studies. The goal is to decorate the effectiveness of visual messages with the aid of tailoring them to the preferences and cognitive style of target audiences [1].

The Function of Computer Learning in Visual Communication

Computer learning, or machine learning (ML) performs a crucial feature in cutting-edge visual communication by means of enabling the automatic evaluation and an era of visible content material. Algorithms may be professional to recognize styles and dispositions in visible records, that can then be used to are expecting target marketplace responses and optimize designs [2]. This technology lets in for the personalization of visual content fabric at scale, enhancing engagement and effectiveness.

Ceramic Packaging Innovative Design

Ceramic packaging design is a specialized yet progressive regional interior product format, specializing within the usage of ceramic materials for package solutions [3]. Ceramics provide unique advantages, which include durability, aesthetic garb, and environmental sustainability. Recent upgrades in this subject have revealed the combination of advanced manufacturing strategies together with 3-D printing, which permits the advent of tough and custom designed packaging designs [4].

Combination Of Visual Communication and Ceramic Packaging

The intersection of visual communique and ceramic packaging design opens up new opportunities for brand differentiation and purchaser engagement. By using standards of visible verbal exchange in ceramic packaging, designers can create visually attractive and functional packaging that stands proud on shelves and enhances the overall product [5]. It is no longer the only way to improve the classy price of the packaging; it additionally has its usability and impact.

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ML Application to Know In Ceramic Design

ML can be used to streamline and enhance the ceramic packing layout manner. For instance, algorithms can examine purchaser preferences and market trends to indicate design adjustments [6]. Additionally, machine learning can assist in first-rate manipulation by detecting defects in ceramic products during the manufacturing technique, making sure of higher requirements and consistency. Furthermore, predictive analytics can forecast demand and optimize stock management, lowering waste and prices [7, 8]. Machine learning models can be employed to simulate special layout prototypes, speeding up the improvement cycle. By incorporating actual feedback, designers can continuously enhance their creations. This synergy of generation and layout fosters innovation, pushing the boundaries of what's feasible in ceramic packaging [9].

Innovative Packaging

Several companies and designers have efficiently applied these combined methods to create groundbreaking packaging answers. For instance, some luxury brands use ceramic packaging for perfumes and cosmetics, leveraging both the top-rate sense of the material and the customized designs enabled by using visual communication analysis and machine learning knowledge. These case research spotlight the capability for creativity and technical excellence in this interdisciplinary subject [10].

Future Trends and Implications

The future of visual communication style analysis and ceramic packaging design will probably see even greater integration of eras and creative's. Advances in AI and system learning will retain to refine and enhance layout techniques, while innovations in material science will amplify the opportunities for sustainable and visually striking packaging solutions [11]. This convergence will pressure the evolution of both fields, supplying exciting possibilities for designers, emblems, and purchasers alike.

The purpose of the paper is to propose spiral-optimized adjustable XGBoost (SO-AXGBoost) to analyze the ceramic packaging design.

The remaining parts of this paper are, part 2 provides the related work, part 3 presents the methodology, part 4 represents the result as well as discussion and part 5 discusses the conclusion of the paper.

Related Work

The augmented reality (AR) cultural packaging design for products model was presented in article [12]. It was based on the concepts of visual engagement and material involvement for AR packaging. An accurate understanding of changes in customer tastes for the cultural packaging of goods was made easier with the help of the approach. Its main use was computer vision technology for tracking and registering augmented reality, which ensures precise overlays of virtual items on physical spaces. As a result, it offered a solid and useful framework for developing clever and engaging product packaging designs.

An innovative image improvement algorithm based on human vision was presented in [13]. Through clever adjustments to image colors, brightness, and contrast, the algorithm significantly improved the aesthetics of packaging designs, which in turn strengthened the attraction of brand packaging. In experimental findings, a data-driven picture improvement algorithm offered a useful new approach to packaging design. With data presentation tools, designers may easily present the three-dimensional model, color coordination, material choices, along other design scheme elements.

Study [14] evaluated how eight different digital presentations of the packaging for cordless kettles affect consumers' propensity to make purchases. The eigenvectors were used to do comparisons between pairs. Three things differentiated the trial conditions: a good's visual context, the length of the product definition, and the backdrop color of the box, which was either black or white. The tone of the background had the least impact among all of the impacts that were evaluated, according to the results of combined analyses of variance. Comprehensive textual content and graphical context were features found in the top-rated designs.

Article [15] examined how design for visual communication is driving national apparel firms' digital transformation using the packaging design. They explained the term visual communications and examined the history of the digital age. Concurrently, the Guochao brand image underwent a digital makeover, and ideas for its implementation were suggested. In addition to serving as a resource and source of inspiration for investigations into brand leadership and visual communication design, it offered practical as well as theoretical advice for the digital evolution of national clothing companies.

The many effects that dispersion and relevance of two aspects of packaging design creativity have on consumer management, argumentation, and engagement measurements were presented in study [16]. It demonstrated that, under some circumstances, packaging design can stimulate consumer curiosity. Furthermore, contrary to past research that mostly concentrated on the advertising context, the findings imply that the impact of packaging design innovation varies considerably in the retail setting. The experimental findings offered novel perspectives and consequences for marketers, management of brands, and packaging designers to comprehend the ways in which creativity influences consumer decision-making.

Paper [17] evaluated the ways of demonstrating brand packaging development using computer-aided design (CAD) to enhance students' design proficiency and efficiency and foster their capacity to formulate ideas creatively and practically. The sharpness and vibrancy of the packaging information were enhanced, and the level of contrast, illumination, and color balance were modified through the design and testing of the image manipulation algorithm. It can save design time and costs while also enhancing the impact and caliber of brand packaging design.

An enhanced convolutional neural network (CNN) based approach for packaging recognition of images and stability tracking that implements packaging creative design through CAD model optimization were proposed in article [18]. Following the method's manufacturing, the amount of noise in the packaging graphic was successfully regulated, the image's basic definition was apparent, the brightness of the image was almost got better and the image was efficiently improved, all of which can improve the cardboard packaging's creative design.

The real qualities and significance of tactile components of ceramic container design were logically analyzed in paper [19]. It was associated with creation from the viewpoints of processes, substances, and conversations, as well as the practical significance of the creative process in fields like language, visuals, shade, and spatial layout. The sensation of touch was crucial to packaging design, which was necessary and it can help further the evolution of ceramic package design and its present legacy.

Study [20] used a computer vision system with deep learning models to explain research and provide an expanded method for fault identification on ceramic parts in an industrial setting. The solution consisted of an image acquisition procedure, a labeling system for generating training data sets, and an image preparation method for supplying a CNN based artificial intelligence algorithm that can operate in real time in an industrial context. An esteemed Portuguese company that produces exquisite stoneware and dinnerware put the created solution into practice and assessed the package.

In order to ensure a wider range of design alternatives for packaging and engagement, leaving packaging as a static item and its originality by considering changes in advances in technology in packaging was demonstrated in paper [21]. The limits of early-stage research originate from the limited use of intelligent and interactive packaging in real-world settings. It was projected that design decisions and improvements in packaging will have a significant practical influence on customers in addition to brand and retail managers.

METHODOLOGY

In this section, we provide a comprehensive explanation for visual communication design in packaging, dataset, feature extraction (discrete wavelet transform), and the proposed method (SO-AXGBoost).

Components Of Visual Communication In The Design Of Product Packaging

Among other design ideas, nationalist sentiments, naturalistic thinking, and green design are used in contemporary packaging. It should also fulfill the standards for a people-centered design, incorporating its ergonomic qualities and eliciting an emotional response from the viewer. However, the majority of cases opt for the standard shape for the packaging framework, with the exception of unique cases, in order to reduce shipping and storage expenses. The depth of the box, the cap, bottom protection, and other significant components should also be taken into account at the same time in order to modify the size appropriately and prevent the design from being overly complex and uneven. Later, as extensively as feasible, the development should be uniformed to prevent rising costs and waste.

Text Design

To enhance the package's design meaning, a well-designed font should complement the item's aesthetic tone. For instance, written by hand styles should be vibrant and straightforward, black fonts should be denser, song fonts should be elegant and respectable, typical fonts should be well-organized and comprehensive, and so on. Occasionally, a variety of characters, such as conventional italics, large, and artwork, will be used in packaging to make it easier for customers to comprehend the product information. In order to satisfy the aesthetically pleasing needs of the majority of customers and gain the necessary edge in competing with similar items, the font layout should be concentrated, cohesive with the main color, and free of strong visual elements. In summary, font design has a variety of effects on package design. As such, designers should consider font design more carefully when creating plans.

Material Design

The aesthetic effect of packing is largely determined by the materials used in its design. We can only achieve a comprehensive and fantastic presentation of shade, written content, structure, and other aspects by selecting the appropriate material. Packaging materials can be classified as natural or artificial. Natural materials have the potential to enhance the product's aesthetic appeal and align it more closely with the concept of natural health. Natural materials are becoming more and more preferred by people who are constantly seeking quality and health, while artificial materials are becoming richer due to ongoing technological advancements.

Visual Design

Abstraction visuals, semi-figurative pictures, and realistic images make up the majority of artwork. In broad terms, abstraction and semi-figurative art are more psychological in nature while figurative artwork is more physical. In order to create visual imagery that sends more confusing information and helps the audience grasp it better, visuals are frequently employed symbolically. This increases the psychological effect of the images while also delivering knowledge. A clear description is necessary for graphics, yet concise does not equate to simple. One must become proficient in using a more condensed method to display richer content in order to appropriately convey the product content in the package.

Symbols of imagery that are intentionally constructed, figurative, and comprehensive are called illustrations. Paying consideration to the aesthetic of visuals and their semantic significance is essential for effective packaging design. In the design of packaging, visuals are essential and serve as a key component of the design language.

Color Design

It can create an established shade of color in the thoughts of customers, facilitating their further assessment of the nature of the item in question. Native engaged color scheme rules to brighten up the visual and enhance the effect of the overall concept. Utilize the current market environment in accordance with the features of the product to comprehend the shifting trends in domestic as well as worldwide popular color schemes, adhere to general and regional guidelines, and make logical decisions on color composition. The functions of the color design are the following:

Attracting customers and enhancing visual perception. Become more visually aware and take appropriate action.

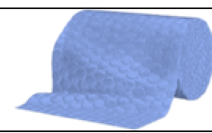
To extend the enjoyment and improve the aesthetic effect. Patterns and colors are added to successful packaging layouts to accentuate the aesthetic appeal of everyday items. These elements can then be portrayed in a variety of artistic mediums to evoke a sense of beauty in the viewer and elicit an emotional response.

Prioritize symbolic meaning and attend to the needs of the emotions. The majority of colors and patterns have distinct symbolic significance. Through their symbolic meanings, patterns, and colors, they can both have an impact on people's psychological and physiological processes.

Dataset

A collection of 600 packaging design datasets was discussed for ceramic products. Each design is labeled based totally on its specific functions and substances used, ensuring an extensive variety of alternatives to suit numerous ceramic objects. Table 1 represents some of the sample designs.

Table 1: Sample dataset

Types of design	Description	Image
The traditional design of boxes	Rectangular or square bins crafted from wood or cardboard, frequently decorated with conventional patterns or motifs.	
Custom-shaped	Boxes are fashioned specially to fit the contours of the ceramic object, offering snug safety throughout transportation.	
Bubble wrap	Wrapped round character ceramic portions to protect towards shocks and impacts in the course of transit	
Eco- friendly	Packaging materials crafted from recycled or biodegradable substances, aligning with sustainable practices in ceramic packaging.	
Air pillows	Inflatable plastic cushions that can be inflated on call to fill empty areas in containers and protect ceramic gadgets from affects.	
Cardboard tubes	Cylindrical tubes made from robust cardboard, appropriate for protective fragile ceramic objects including vases or figurines.	

Feature Extraction

The discrete wavelet transform (DWT) was used for feature extraction. It is utilized in visual communication style analysis to decompose images into specific frequency additives, revealing styles and textures relevant to design aesthetics. In the context of ceramic packaging layout innovation, DWT helps analyze intricate information and structural integrity, assisting in optimizing fabric use and visible appeal. This technique complements design precision by capturing diffused variations in texture and pattern, which is crucial for developing aesthetically captivating and useful ceramic packaging solutions. A mathematical method called the DWT was created to effectively evaluate fast-moving, non-stationary data across a wide range of frequencies. Wavelets are a type of irregularly shaped signal that is concentrated in both time as well as scale. The DWT can divide a signal into constituent wavelets by breaking it down into several scaled and altered versions of an initial wavelet. Micro wavelets can be used to identify the minute characteristics in a signal that contain high-frequency components, while bigger wavelets can be used to identify the coarse features. These wavelets can be additionally destroyed to remove some of the details. The majority of the data contained in an image is stored in the low frequency sub-band, whereas the high-frequency signals sub-bands show the more intricate details, including the borders of the initial image.

It can be expressed as the formula for the matrix $H' = XHX^S$, where is an AXA image, y is the A×A transformation matrix, and h_n is the converted A×A matrices that result, containing H'. The range of$h_n(y)$, where n spans from$y \in [0,1]$, is where the function in question is defined. This function can be split down as follows:

$$n = 2^r + l \tag{1}$$

Where l denotes the residual, or $l = 2^r - n$, and r is the largest power of 2 that is found in the number n. The basis functional is defined in Equation (2).

$$h_n(y) = \frac{1}{\sqrt{M}} \begin{cases} 1 \; if \; n = 0\xi 0 \le y \le 1 \\ 2^{r/2} \; if \; a > 0\xi l\,/2^r \le y < \frac{l+0.5}{2^l} \\ 2^{r/2} \; if \; n > 0\xi (l+0.5)/2^r \le y < \frac{l+1}{2^l} \\ 0 \; Elsewhere \end{cases} \tag{2}$$

The opposite conversion kernel, specified in Equation (3), can be substituted to find the transition matrices for the two-dimensional DWT.

$$h'(y,n) = \frac{1}{\sqrt{M}} h_n\left(\frac{y}{M}\right) \; for \; y = 0,1,2,\dots,M-1 \tag{3}$$

As a result, the transform matrix (H') that results will be:

$$h(n,z) = H' = \begin{bmatrix} h_0\left(\frac{0}{M}\right) & g_0\left(\frac{1}{M}\right) & \cdots & h_0\left(\frac{M-1}{M}\right) \\ h_1\left(\frac{0}{M}\right) & g_1\left(\frac{1}{M}\right) & \cdots & h_1\left(\frac{M-1}{M}\right) \\ h_2\left(\frac{0}{M}\right) & g_2\left(\frac{1}{M}\right) & \dots & h_2\left(\frac{M-1}{M}\right) \\ \vdots & \vdots & \ddots & \vdots \\ h_{M-1}\left(\frac{0}{M}\right) & h_{M-1}\left(\frac{1}{M}\right) & \cdots & h_{M-1}\left(\frac{M-1}{M}\right) \end{bmatrix} \tag{4}$$

Investigating How to Innovate Product Packaging Design Through The Use Of Visual Communication

In this section, we proposed spiral-optimized adjustable XGBoost (SO-AXGBoost) to classify and evaluate the variables influencing packaging design for products in visual communication to investigate the product packaging design is evolving through innovative use of visual communication.

Spiral Optimization Algorithm (SOA)

The SOA is a computational technique inspired by the natural process, used to optimize complex problems in various fields. In visible communication style evaluation, SOA integrates algorithms to investigate and enhance visual content presentation. When applied to ceramic packaging design innovation, SOA can optimize design parameters which include material utilization, structural integrity, and aesthetic enchantment, fostering innovative solutions in product packaging. The following formula represents the discrete exponential spiral structure that fulfills the need that the exact center can be found at any point:

$$w^{(l+1)} = qN(\theta).w^{(l)} - (q.N(\theta) - J_m).w^* \quad (5)$$

When using the one-point searching approach, the search is based on equation (5). Such w^* does not function fully since, when evaluating the beginning point, it turns out to be the best answer and the center w^*. It is a multipoint search method based on:

$$w_j^{(l+1)} = qN(\theta).w_j^{(l)} - (q.N(\theta) - J_m).w^*, \quad j = 1,2,\ldots,N \quad (6)$$

Regarding the best result found during the search procedure being the common center, w^*. That is w^* turns into an association. The following are the implications of adding the association and embracing the multipoint:

Multipoint: Role in improving the spiraling model's intensity and diversity.

Association: Role in the realization of the necessary intensity around a workable solution.

The direction of rotation about the center at every k is $0 \leq \theta < 2\pi$, and the speed of convergence of the travel distance separating a point and the origin at each k is $0 < q < 1$. The rotational matrix is $N(\theta)$. The following is the definition of the matrix of rotation for two-dimensional SOA:

$$N_{1,2}^{(2)}(\theta) = \begin{bmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{bmatrix} \quad (7)$$

$N^{(m)}(\theta)$, the structure of the rotation matrices, is made up of a rotational matrix based on every combination $(m(m-1)/2)$ of two axes, as shown in Equation (7). M(n) (h) has the following definition:

$$N^{(m)}(\theta) = \prod_{j<i} N_{j,i}^{(m)}(\theta_{j,i}) \quad (8)$$

Adjustable XGBoost (AXGBoost)

This technique leverages AXGBoost's flexibility in managing complicated fact patterns to investigate and decorate visible communication factors. By integrating system learning into design innovation, AXGBoost's objectives are to optimize packaging aesthetics, capability and consumer enchantment. This interdisciplinary technique bridges the space between facts-driven insights and innovative design answers, paving the manner for more advantageous client engagement and product differentiation in the ceramic packaging enterprise.

The extended logistic machine learning method based on the enhanced decision tree is partially implemented by the AXGBoost algorithm, which is a component of a traditional ensemble approach. Control processing unit (CPU) threading can be used by the AXGBoost model to achieve optimal parameters and enable parallel processing. For the computation of the objective of the function, in Equation (9).

$$obj(\theta) = K(\theta) + \Omega(\theta) \quad (9)$$

The losses function, $K(\theta)$, and the modeling parameter, θ are included. The accuracy of the model increases with increasing value. This phenomenon results from the model's ease of mistaking noise for a learning sample. When a model forecasts data that is known well but it has low predictive power for unreliable information, it is said to be overfitting. This phenomena weakens the model's resilience.

The normalization term $(\Omega(\theta))$ can enhance both the assessment of the algorithm's intricacy and generalization capabilities. In the XGBoost model, let k be the number of ensemble trees.

$$z_j = \sum_{l=1}^{l} e_l(w_j), e_l \in \rho \tag{10}$$

The foundation classifier in equation (10) whereas l and ρ stand for the starting classifier's quantity and the environment, respectively. Equation (11) illustrates the derivation of the objective function if z_j stands for the class j mark.

$$obj = \sum_{j=1}^{m} K(z_j, \hat{z}_j) + \sum_{l=1}^{l} \Omega(e_l) \tag{11}$$

In basic terms, the XGBoost model is a synthetic model, it is an enhanced tree model with a unique shape. In order to solve the algorithm's objective function, every tree K must be obtained. To arrive at the first tree, one must train using the model that has been repeated numerous e_l times, as all trees e_l are not possible to get at once. Equation (12), which displays the goal function of the first repetition can be generated on the information mentioned above.

$$obj^{(s)} \approx \sum_{j=1}^{m} \left[h_j e_s(w_j) + \frac{1}{2} g_j e_s^2(w_j) \right] + \Omega(e_s) \tag{12}$$

The objective function's initial and subsequent components correspond to h_j and w_j. The framework can obtain the best classification effect after reducing the objective function, increasing the accuracy of the prediction. To get the most effective projection impact subsequently, the algorithm should be trained using the data test set. Then, each AXGBoost variable should be adjusted to achieve the method's ideal parameters. Additionally, the algorithm's tree structures need to be simplified.

SO-AXGBoost

The hybrid approach of Spiral Optimized Adjustable XGBoost (SO-AXGBoost) combines the adjustable XGBoost (AXGBoost) with more advantageous optimization through a spiral optimization algorithm (SOA). It pursues to enhance visual communication design analysis by a leveraging strong characteristic choice and model tuning skills. Integrating this method with ceramic packaging layout innovation facilitates advanced predictive modeling and decision-making, contributing to advanced product aesthetics and capability. This synergistic technique harnesses system learning's energy to optimize layout procedures and decorate product design. Algorithm 1 represents the SO-AXGBoost algorithm.

Algorithm 1: SO-AXGBoost algorithm

$Step\ 1: data\ =\ load\_data()$

$Step\ 2: X, y\ =\ preprocess\_data(data)$

$Step\ 3: X\ =\ feature\_engineering(X)$

$Step\ 4: X\_train, X\_test, y\_train, y\_test\ =\ train\_test\_split(X, y, test\_size = 0.2, random\_state = 42)$

$params\_xgb\ =\ \{$

$'objective': 'binary: logistic',$

$\}$

$Step\ 5: best\_params\_xgb\ =\ spiral\_optimization(params\_xgb, X\_train, y\_train)$

$Step\ 6: model\_xgb\ =\ XGBoost(params = best\_params\_xgb)$

$Step\ 7: model\_xgb.train(X\_train, y\_train)$

$Step\ 8: accuracy\ =\ model\_xgb.evaluate(X\_test, y\_test)$

$Step\ 9: predictions\ =\ model\_xgb.predict(X\_test)$

$Step\ 10: print(f"Accuracy: \{accuracy\}")$

$Step\ 11: def\ load\_data():$

```
  pass
def preprocess_data(data):
  pass
def feature_engineering(X):
  pass
def train_test_split(X, y, test_size, random_state):
  pass
def spiral_optimization(params, X_train, y_train):
  pass
```

$Step\ 12: class\ XGBoost:$

```
  def __init__(self, params):
    pass
  def train(self, X_train, y_train):
    pass
  def evaluate(self, X_test, y_test):
    pass
  def predict(self, X_test):
pass
```

RESULT AND DISCUSSION

In this section, we evaluate the performance of before optimization (AXGBoost) and after optimization (SO-AXGBoost) based on the matrices such as inference time. Problems that occur while packaging, visual representation, size, color and package focus were evaluated.

Inference Time

It refers to the time durations and producers involved in decoding and understanding the visible cues and messages conveyed by the packaging layout. This encompasses how quickly and correctly clients and stakeholders can perceive and realize the intended branding, commands, safety warnings and product statistics offered in the packaging. Table 2 and Figure 1 represent the inference time before and after optimization. Figure 1, before optimization, contains 45s, and after optimization contains 25s to predict. Based on the findings, optimization outperformed others in inference times.

Table 2: Inference time before and after optimization

Method	Inference time (s)
Before optimization	45s
After optimization	25s

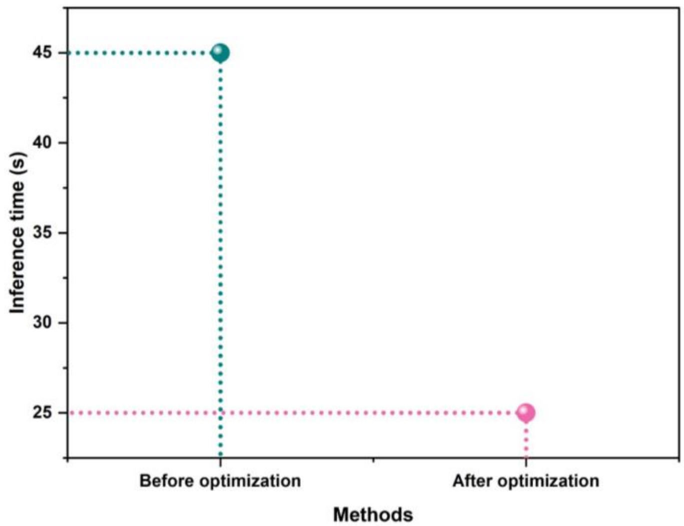


Figure 1: Performance of Inference time

Packaging Problems

We evaluate the five main problems before and after optimization including cost-effectiveness, aesthetic appeal, customer experience, sustainability and balance of weight in both before and after optimization. Table 3 and Figure 2 displays the evaluation of problems in both before and after optimization. In Figure 2, before optimization attained cost-effectiveness (80%), aesthetic appeal (95%), customer experience (89%), sustainability (85%), and balance of weight (92%). When compared to the before optimization, after optimization attained sustainability (79%), customer experience (83%), cost-effectiveness (70%), balance of weight (85%), and aesthetic appeal (80%). According to the findings, the problems are decreased after optimization compared to before.

Table 3: Evaluation of problems in both before and after optimization

Problems	Before optimization	After optimization
Cost-effectiveness	80%	70%
Aesthetic appeal	95%	80%
Customer experience	89%	83%
Sustainability	85%	79%
Balance of weight	92%	85%

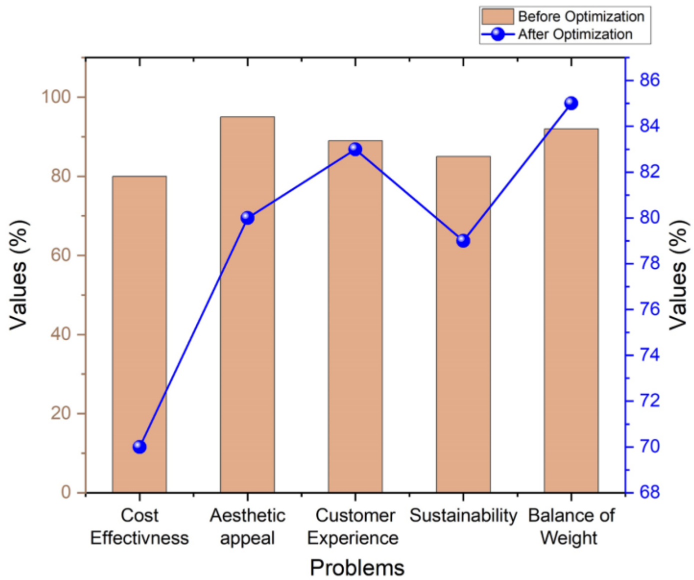


Figure 2: Evaluation of problems in both before and after optimization

Visual Representation Of Ceramic Packaging

Powerful visual performance can elicit a wider range of psychological reactions from customers and, to some extent, may successfully contact consumers in order to achieve effective advertising for ceramic packaging boxes. Its artistic visual components can be successfully fractured down into dimensions such as design, structure, anxiety, and balance. Figure 3 displays the current ceramic containers used for packaging for the data analysis findings' visual presentation. In Figure 3 from the standpoint of the visual components of ceramic packaging boxes, performance in terms of design, structure and anxiety increased between 2017 and 2024 and decreased in terms of balance.

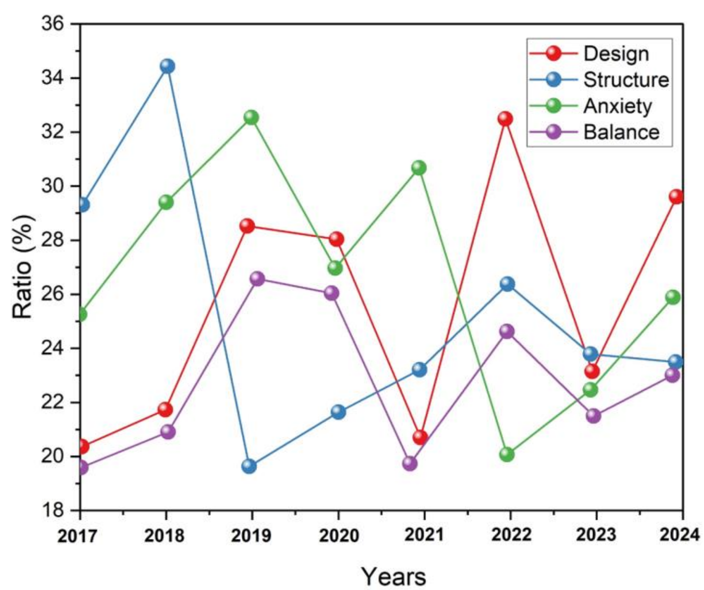


Figure 3: Visual representation of ceramic packaging

Size

We calculate the size of the product to predict the innovative design packaging. Table 4 and Figure 4 represent the performance of size. Our proposed method performs effectively for small (90%) and medium (83%) sized products. However, for large sized products, our proposed method performs (70%).

Table 4: Performance of size

Size	Percentage
Small	90%
Medium	83%
Large	70%

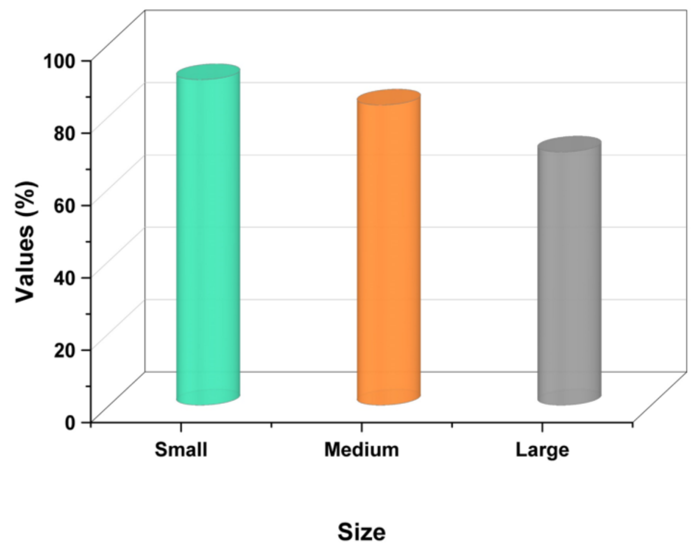


Figure 4: Performance of size

Color

We evaluate the color preference of packaging and we get five main colors including white, blue, green, black and red. Table 5 and Figure 5 represent the color preference of packaging. In Figure, the white color attained (60%) because of simplicity and elegance, and the blue color indicate calmness so it achieved (55%). The green color (50%) is for the freshness and symbol of nature, the black color (58%) is preferred for luxury and the red color (53%) for energy and celebration. According to the findings, most of the people prefer white color packaging.

Table 5: Colour preference of packaging

Color name	Percentage of the people
White	60%
Blue	55%
Green	50%
black	58%

Red	53%

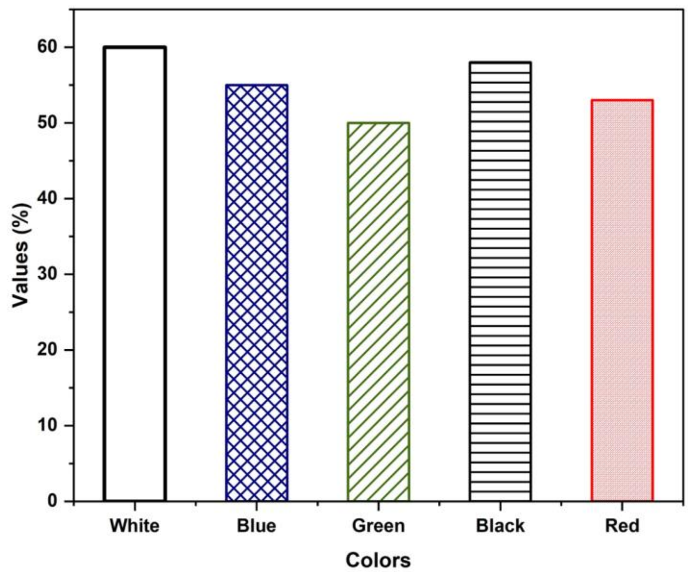


Figure 5: Color preference of packaging

Package Focus Under Visual Communication Style

The package focused on the logo, eco-friendly, aesthetics, quantity and material innovation. Table 6 and Figure 6 represent the package focus. We calculate the performance based on the total amount of people and proportions. In the figure, logo (total amount of people (75%) and proportions (70%)), eco-friendly (total amount of people (69%) and proportions (57%)), aesthetics (total amount of people (81%) and proportions (84%)), quantity (total amount of people (82%) and proportions (78%)) and material innovation (total amount of people (79%) and proportions (62%)). According to the findings, most people focus on quality and aesthetics.

Table 6: Package focus

Areas	The total amount of people	Proportions
Logo	75%	70%
Eco-friendly	69%	57%
Aesthetics	81%	84%
Quality	82%	78%
Material innovation	79%	62%

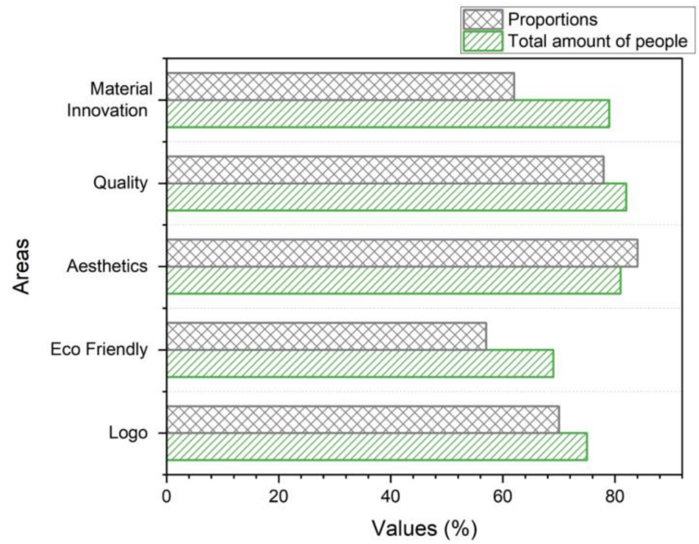


Figure 6: Performance of package focus

CONCLUSION

Ceramics are used as a component material for each of these components, which is why the container is called a ceramic package. A unique approach to product packaging design focuses on generating financial benefits through raising product sales and improving brand recognition. The challenges vary in size and weight, from ceramic to plastic packing. Production and testing of ceramic packaging could lead to cost increases. In this paper, we introduce spiral-optimized adjustable XGBoost (SO-AXGBoost) to evaluate the ceramic packaging design with a visual communication style. We discussed 600 packaging design datasets. We used the discrete wavelet transform (DWT) for feature extraction. As a result, we demonstrate that ceramic package designing may be evaluated before optimization, package design evaluation was more successful after optimization. It shows that visual communication style analysis and efficient methods for learning ceramic package design can be combined. Packaging that is both functional and aesthetically pleasing is enhanced by this innovative technique, which also improves consumer preferences and market trends.

FUTURE SCOPE AND LIMITATION

Larger ceramic products may pose demanding situations in terms of fitting into standardized packaging sizes or may additionally require custom packaging solutions, which may be costlier and less effective for mass manufacturing. Heavy ceramic merchandise can increase packaging expenses because of the desire for more materials and longer long-lasting substances, impacting both manufacturing and transportation expenses. Future studies can recognize growing modular packaging designs that may be adjusted or customized to deal with diverse sizes of ceramic products efficiently. Exploring light-weight but long lasting materials suitable for protecting large ceramic merchandise may result in improvements in sustainable packaging solutions.

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