

From Brushstrokes to Texture: Content Analysis of Qi Baishi's Shrimp Paintings and Exploration of AI Reproduction

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Abstract

This study explores the regeneration of Qi Baishi's renowned shrimp paintings using artificial intelligence, guided by a systematic content analysis framework. We first deconstruct the master's style by identifying and categorizing key visual elements, including line fluidity, ink intensity, dynamic expression, and negative space composition. These artistic features are then translated into descriptive labels to train a specialized Low-Rank Adaptation (LoRA) model based on a diffusion framework. The generated works are evaluated for stylistic fidelity and emotional resonance, with results indicating a high degree of similarity to Qi Baishi's originals in morphology and dynamism. However, the study also notes limitations in the AI's ability to replicate the nuanced subtleties of ink techniques and deeper emotional expressions. This research validates the effectiveness of content analysis in bridging traditional art aesthetics with computational generation, offering a new pathway for the preservation and innovative reinterpretation of cultural heritage.

Keywords Qi Baishi; AI Art Generation; Content Analysis; Diffusion Models; Chinese Ink Painting

1 Introduction

1.1 Research Background

Qi Baishi (1864–1957) was a renowned modern Chinese painter and calligrapher, celebrated for his works depicting flowers, birds, landscapes, and animals. His shrimp paintings exemplify a unique artistic style and profound perception of natural life. In Qi Baishi's works, shrimp are not merely representations of natural forms but also symbolize vitality and dynamism in traditional culture. Through minimalist brushstrokes and fluid lines, he captured the form of shrimp, imbuing them with energy and movement, making them iconic subjects throughout his artistic career. By manipulating the weight, speed, and thickness of his ink strokes, Qi Baishi recreated the shrimp's resilient shells and soft bodies, demonstrating his keen observation of life and profound artistic mastery.

With modern technological advancements, Artificial Intelligence (AI) has gradually permeated the field of artistic creation. Through deep learning and computer vision techniques, AI can not only mimic the stylistic appearance of artworks but also, to some extent, comprehend and reproduce their emotional essence. Particularly in image generation and recreation, AI-generated art has emerged as a new interdisciplinary research direction. However, effectively applying AI technology to regenerate traditional art—especially works like Qi Baishi's shrimp paintings, which are rich in emotional expression and unique artistic style—still faces numerous challenges.

1.2 Research Purpose and Significance

This study aims to extract key visual features and emotional expressions from Qi Baishi's shrimp paintings through content analysis and combine them with AI image generation technology to achieve their regeneration. Content analysis is a systematic analytical method based on the visual elements of artworks. It identifies and records key features reflecting the artist's style and emotional expression through detailed observation of visual elements such as brushstrokes, color, and composition. By integrating these visual features into AI generative models, this research seeks to faithfully reproduce the style of Qi Baishi's shrimp paintings while exploring the potential of AI technology in traditional art recreation.

The significance of this research lies in enriching AI applications in the arts and promoting the integration of traditional art with modern technology. It explores AI's auxiliary role in the artistic creation process. Furthermore, through the content analysis methodology, this study enables a deeper understanding of the artistic style and emotional expression in Qi Baishi's shrimp paintings, providing reliable data and theoretical support for subsequent research.

2 Theoretical Background

2.1 Artistic Characteristics of Qi Baishi's Shrimp Paintings

The unique charm of Qi Baishi's shrimp paintings stems from his profound understanding of natural observation and exceptional ink techniques. Guided by the artistic philosophy of "less is more," he combined minimalist lines, subtle ink tones, and vivid shrimp forms, making the shrimp appear lifelike. His shrimp paintings transcend mere representation; they express the vitality of nature. Every part of the shrimp—body, antennae, and tail—is endowed with distinct dynamism through meticulous ink treatment.

Emotional expression is also integral to Qi Baishi's art. His highly personalized brushwork conveys the shrimp's liveliness and agility. This technique is not just a skill but an expression of his love for life and reverence for nature. Through precise ink control and unique composition, this emotional expression profoundly influenced the development of traditional Chinese bird-and-flower painting.

2.2 Content Analysis

Content analysis is a research method for deeply exploring visual features and emotional expressions in artworks, originating from the tradition of detailed observation and analysis. It is widely applied in product design, visual arts, interaction design, and other fields. The core concept involves identifying elements that evoke emotional resonance in viewers through detailed analysis of visual components like color, lines, and composition.

In art creation, content analysis focuses on *how* artists use visual elements to convey emotion. Taking Qi Baishi's shrimp paintings as an example, the analysis would concentrate on key visual features such as the shrimp's lifelike posture, fluidity of lines, and variations in ink intensity. These features form the foundation of the artwork's imagery and are crucial for emotional transmission. Content analysis enables the quantification of these visual characteristics, transforming them into parameters understandable and reproducible by AI.

2.3 Overview of AI Art Generation Technology

AI applications in art generation primarily rely on deep learning and computer vision techniques. Common image generation models include Generative Adversarial Networks (GANs), Diffusion Models, and Variational Autoencoders (VAEs). GANs are among the most widely used models in image generation, producing new images stylistically consistent with input data through adversarial training of generator

and discriminator networks. Diffusion models generate images by simulating natural diffusion processes and have recently achieved significant progress in high-quality image synthesis.

In traditional art regeneration, AI's role extends beyond generating visually similar works; it must also comprehend the emotion and style infused by the artist. This demands higher AI comprehension capabilities, requiring interdisciplinary techniques like art theory and affective computing for effective artistic reproduction.

3 Research Methodology

3.1 Image Processing and Data Preparation for Qi Baishi's Shrimp Paintings

To achieve AI regeneration of Qi Baishi's shrimp paintings, digital images of the artworks are required. Representative shrimp paintings were selected, scanned at high resolution, and digitized. Image processing techniques were used to remove noise, stains, and other interfering factors, ensuring the AI training process focuses on the core visual features of the paintings.

During data preparation, elements such as lines and ink tones within the paintings were annotated for subsequent visual content extraction and AI model training. For instance, shrimp antennae and body lines underwent separate layering to ensure the AI could independently learn the brushstroke styles and morphological features of these parts. Additionally, image enhancement techniques were employed to magnify local shrimp details, facilitating more precise identification and imitation of the paintings' characteristics by the AI model.

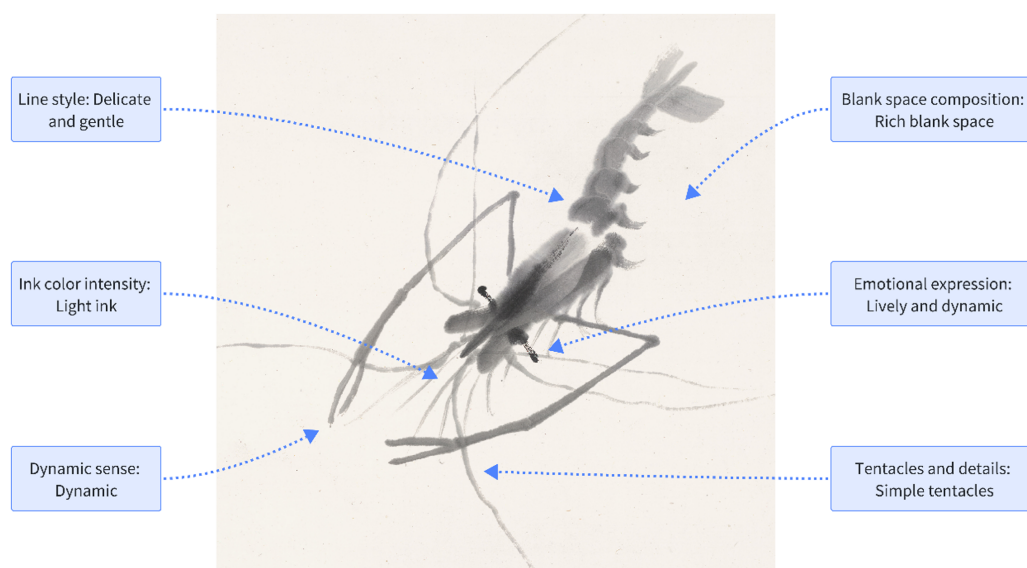


Figure 1: Process Qi Baishi's shrimp paintings

3.2 Application of Content Analysis

Content analysis is a critical step in this research. Through in-depth analysis of Qi Baishi's shrimp paintings, their stylistic features are categorized into a series of visual elements, including: line fluidity, ink intensity variation, dynamic expression of shrimp, and use of negative space in composition. Each visual element acts as a carrier for conveying emotion within the artwork.

To apply content analysis, deep learning-based image feature extraction techniques were utilized. First, the BLIP (Bootstrapping Language-Image Pre-training) model performed preliminary extraction of visual

features from the shrimp paintings, including line morphology and brushstroke texture. Subsequently, an affective computing model linked these visual features to the emotional expressions in the artworks. For example, fluid lines might symbolize lighthearted joy, while heavy ink tones could express intense emotional tension. Finally, these analytical results were compared with historical documents and insights from art critics to validate conclusions about emotional expression.

Table 1: Visualization of Artistic Features

Artistic Feature Category	Characteristic Description	Artistic Feature Category	Characteristic Description	Detailed Explanation
Line Style				
Delicate & Soft	Fine, soft lines showcasing delicate brushwork	Ink Intensity	Concentrated Ink	Vigorous & forceful, thick lines conveying solidity
Vigorous & Forceful	Thick, powerful lines conveying solidity		Light Ink	Fluid & free brushstrokes
Fluid & Free	Flowing, natural brushstrokes		Gradient Ink	Subtle transitions of tone and shading
Dynamic Expression				
Static	Subjects appear motionless, serene and steady	Antennae & Details	Simplified Antennae	Minimal features, abstracted forms
Dynamic & Light	Subjects exhibit motion, seemingly in action		Detailed Antennae	Realistic, carefully depicted antennae
Swift Swimming	Movements are agile and quick, conveying liveliness		Exaggerated Details	Overstated elements to enhance expressiveness
Negative Space Composition				
Ample Negative Space	Significant empty areas, open composition inviting imagination	Emotional Expression	Peaceful & Natural	Calm, harmonious atmosphere
Strong Contrast	Sharp contrast between subject and background		Lively & Playful	Vibrant, cheerful depiction
			Strength & Tranquility Coexist	Balance of vitality and serenity

The diversity and depth brought by these six dimensions are perfectly exemplified in Qi Baishi's shrimp paintings. Delicate, soft lines manifest in the subtlety and gentleness of the shrimp antennae, each stroke revealing exquisite brushwork, as if the antennae sway gently in water; vigorous, forceful lines appear in the depiction of shrimp claws, showcasing power and solidity; fluid, free lines emerge in the curves of the shrimp bodies, naturally smooth, resembling the posture of shrimp swimming freely.

In the use of ink intensity, concentrated ink depicts shrimp claws and heads, creating a profound texture with dark ink; light ink expresses the translucency of shrimp bodies, showing the subtle shadows of pale ink; gradient ink appears on the shrimp's back and abdomen, achieving a sense of three-dimensionality and liveliness through soft ink transitions.

Dynamism is equally important in Qi Baishi's shrimp paintings. Static compositions exhibit a stillness filled with tension, while dynamic compositions capture moments of shrimp swimming or foraging, brimming with vitality. The skillful use of negative space provides ample breathing room, making the shrimp subjects stand out more prominently. Simultaneously, strong contrast between subject and background captures the viewer's attention.

In antennae and detail treatment, Qi Baishi's simplified antennae express the shrimp's agility with

concise lines, while detailed antennae focus on meticulous rendering. Exaggerated details enhance visual impact by emphasizing claw shapes and textures. Emotionally, his shrimp paintings convey peace and harmony with nature, while the shrimp's lively nature embodies the vitality of life. The coexistence of strength and tranquility finds perfect balance in the solidity of claws and the calmness of water ripples. These elements collectively form the rich visual language of Qi Baishi's shrimp paintings.



Figure 2: Qi Baishi's concrete description of shrimp

Using these tags, we can classify and describe Qi Baishi's shrimp paintings, aiding the model in understanding and generating works that align with his style during training.

3.3 AI Model Design and Training

To ensure the generative model could faithfully reproduce Qi Baishi's shrimp painting style, this study employed a diffusion model as the primary image generation framework. Diffusion models generate high-fidelity images by progressively adding noise to an image and then training a process to reverse this (denoising). Starting from a noisy image, the diffusion model iteratively removes noise to generate images approximating Qi Baishi's style.

We utilized the LoRA (Low-Rank Adaptation) extension for the diffusion model to train a specialized LoRA model for Qi Baishi's shrimp paintings. The visual elements extracted from his works were incorporated as dataset labels during LoRA training, ultimately generating shrimp paintings with specific emotional and stylistic characteristics. The extracted visual elements were encoded as input features and embedded into the diffusion model's neural network. Through the denoising process, the LoRA model gradually learned to reproduce key features such as line fluidity, ink intensity variation, and dynamic expression.

Nearly a hundred digital images of Qi Baishi's shrimp paintings were used as the training set, ensuring the model could generate stylistically consistent works under diverse conditions. Multiple evaluation metrics were set during training to improve stylistic consistency, including image style similarity, emotional expression consistency, and visual feature matching. Through multiple rounds of training and optimization, the LoRA model progressively mastered the unique artistic style of Qi Baishi's shrimp paintings.

4 Generation Results and Analysis

4.1 Showcase of AI-Generated Shrimp Paintings

After multiple rounds of training and optimization, the generative model produced works closely resembling Qi Baishi's style. The detailed analysis of experimental results is as follows: Key prompts were used for regeneration: Shrimp, Chinese ink painting, delicate and soft brushstrokes, smooth lines, ink color gradient, rich white space, natural and peaceful emotions, smart dynamics. Different AI base models were also employed to explore stylistic variations.

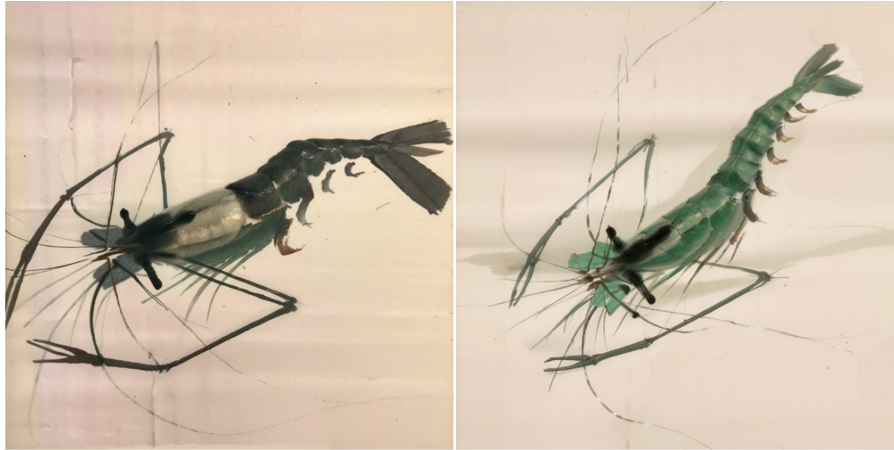


Figure 3: Qi Baishi's concrete description of shrimp



Figure 4: Qi Baishi's concrete description of shrimp

Visually, the generated shrimp paintings exhibit strong similarity to Qi Baishi's originals in line fluidity, ink variation, and composition. The generator, through learning visual elements, accurately reproduced shrimp postures, body curves, and the dynamic expression of antennae. Particularly in ink treatment, the AI-generated works retained the "harmonious balance of intensity" characteristic of Qi Baishi's paintings, filling the images with vitality. Regarding emotional expression, the AI-generated works successfully conveyed the emotional resonance found in the originals. By extracting and analyzing visual elements, the AI captured the agility and vitality expressed in the original works, ensuring the generated paintings were consistent both morphologically and emotionally. The dynamic expression of the shrimp and the nuanced ink variations endowed the generated works with emotional depth, enhancing their artistic impact.

To further validate the quality of the generated works, multiple art experts evaluated the AI-generated shrimp paintings. Experts agreed that the stylistic imitation was highly accurate. The AI effectively cap-



Figure 5: Qi Baishi's concrete description of shrimp

tured the core artistic characteristics of Qi Baishi's shrimp paintings, particularly in line expressiveness and emotional conveyance, achieving a level of verisimilitude. While minor differences existed in subtle details (e.g., local brushstroke treatment), overall, the AI-generated shrimp paintings closely approximated Qi Baishi's artistic style.

4.2 Evaluation of Content Analysis Application Effectiveness

The application of content analysis in this study significantly enhanced the effectiveness of AI art regeneration. By systematically analyzing the visual features and emotional expressions of Qi Baishi's shrimp paintings and quantifying them, we successfully identified key visual elements reflecting the artistic style and effectively integrated them into the generative model. During experiments, we found that accurate content analysis was crucial for output quality. Key visual elements reflecting line fluidity, ink intensity variation, and dynamic expression substantially improved the generated works' stylistic similarity and emotional consistency. Experimental results demonstrate that content analysis opens new pathways for AI-generated art. It focuses not only on surface image features but also delves into layers of emotional expression, enhancing AI's expressive power in art regeneration. Compared to traditional image generation methods, content analysis enables generated works to possess richer emotional depth, ensuring AI outputs are not merely formal imitations but genuine transmissions of emotion and style.

5 Conclusion and Outlook

Comparing AI-generated works with Qi Baishi's originals reveals high stylistic consistency, especially in morphological and dynamic detail processing. However, AI exhibits limitations in reproducing the flexibility of ink techniques and deeper emotional nuances, showing characteristics of "regularity" and "mechanization," lacking the natural flow. Emotionally, while the AI conveyed some elements, its handling of subtle ink variations and "negative space" was less sophisticated, resulting in shallower emotional expression. Furthermore, AI art generation depends heavily on the scale and quality of training data and struggles to comprehend the artist's emotional motivations, making some aspects appear less inspired.

Nonetheless, AI holds immense potential in art generation. With advancements in deep learning, breakthroughs in emotional expression are anticipated. Optimizing content analysis could enable high-quality regeneration across more art domains. This research demonstrates that content analysis effectively extracts stylistic and emotional features from artworks. This significantly supports AI's role in art generation, enabling AI-generated shrimp paintings to achieve high stylistic fidelity to Qi Baishi's originals,

particularly excelling in line fluidity and ink variation. Despite minor differences in details, the outcomes showcase AI's potential in traditional art regeneration, proving its ability to mimic not just appearances but also emotional expression.

Future research should optimize content analysis, especially for nuanced emotional expression, explore integrating more artworks into AI training models, and extend AI applications to music, literature, and other fields. This will promote broader interdisciplinary applications, better assist artistic creation, and provide new momentum for the inheritance and development of traditional art.

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