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New algorithms for Embroidery Patterns Using Feature Extraction and Pattern Recognition

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ABSTRACT

The paper presents an innovative design system for traditional embroidery patterns using a linear classifier-type intelligent algorithm model in computer science. Recognizing the limitations of conventional, artisan-dependent embroidery design such as constrained creativity and pattern diversity the study proposes an AI-driven approach to automate and enhance pattern innovation while preserving cultural essence. The system involves preprocessing embroidery images, extracting geometric, textural, and structural features, and applying linear classifiers like Support Vector Machines and Logistic Regression to categorize and generate new designs. A user friendly visual interface allows customization, fostering personalized creativity. Experimental validation includes dataset partitioning, algorithm comparison, and performance evaluation using metrics like accuracy, recall, and F1 score. Results indicate that the linear classifier effectively identifies pattern features and supports the generation of innovative designs. The research fills a gap in intelligent systems explicitly tailored for embroidery, as most prior work focused on digital art or painting. By integrating machine learning with traditional craftsmanship, the system not only modernizes embroidery design but also contributes to the preservation and evolution of cultural heritage. The authors suggest exploring alternative algorithms to refine performance further and broaden the application scope. Overall, the study demonstrates the feasibility and practical value of intelligent algorithms in revitalizing traditional art forms through computational innovation.The Innovation Design System for Traditional Embroidery Patterns Based on the Linear Classifier type Intelligent Algorithm Model in Computer

Keywords: Traditional Embroidery Pattern, Linear Classifier, Intelligent Algorithm Model Feature Extraction, Machine Learning, Pattern Recognition, Computer Aided Design

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1. Introduction

Embroidery, recognized as a classic craft technique, boasts a rich history across numerous cultures. It serves not merely as an ornamentation but also as a means of expressing culture and artistry [1]. Nevertheless, as modern technology advances, the creativity and innovation of traditional embroidery designs encounter obstacles. The conventional embroidery design process often relies on individual expertise and artists' creativity, which can limit the variety and originality of embroidery patterns. Thus, the question of how to leverage computer intelligent algorithms for the innovation and design of traditional embroidery patterns has emerged as a significant area of study. Recently, the integration of computer intelligent algorithms within the realms of art and design has garnered considerable attention. By employing machine learning and pattern recognition algorithms, computers can evaluate and comprehend the traits and patterns of artworks, leading to the creation of new artistic pieces. However, there is a relative scarcity of research focused on intelligent design systems for traditional embroidery patterns [2]. Consequently, we propose a novel design system for traditional embroidery patterns grounded in the linear classifier type intelligent algorithm used in computers. This research aims to create an intelligent design system capable of automatically producing innovative embroidery patterns [3]. This system is founded on the linear classifier type algorithm model, which can analyze and identify the components of traditional embroidery patterns and generate innovative new designs through learning and optimization. By incorporating computer intelligent algorithms, we aspire to transcend the limitations of traditional embroidery design and enhance the variety and creativity of embroidery patterns [4]. The key contributions of this research include introducing an innovative design system for traditional embroidery patterns based on a linear classifier type intelligent algorithm. This system is capable of automatically creating inventive embroidery patterns while preserving the essence and characteristics of traditional embroidery through learning and optimization. A model for feature extraction and classification of embroidery patterns is developed. By extracting and comprehending the features of traditional embroidery patterns, the system can accurately identify and categorize their elements, providing a foundation for innovative design. Additionally, a visual interface for the innovative design of embroidery patterns is established [5]. This interface allows users to interact and modify designs to generate unique embroidery patterns according to their preferences. In this study, we will conduct a series of experiments to assess the performance and outcomes of the proposed innovative design system for traditional embroidery patterns. Real embroidery pattern datasets will be utilized for training and testing, and comparisons will be made with traditional embroidery design methods. Through the analysis of experimental data and comparisons of results, we anticipate verifying the system's innovative capabilities and practicality. In conclusion, this research seeks to investigate an innovative design system for traditional embroidery patterns grounded in the linear classifier-type intelligent algorithm model in computers. By integrating computer intelligent algorithms, we aim to overcome the constraints of traditional embroidery design and foster innovation and diversity in embroidery patterns. This research holds significant importance for advancing the evolution of traditional embroidery art and enhancing the efficiency and creativity of embroidery design [6].

2. Early Studies

Embroidery, recognized as a time-honored craft, boasts a history spanning thousands of years. Across various cultures, it finds extensive application in areas such as apparel, household textiles, and decorative arts. Traditional embroidery designs predominantly rely on skilled artisans who express creativity and artistry through hand stitching. Nevertheless, with advancements in contemporary technology, computer based intelligent algorithms are increasingly utilized in art and design, presenting fresh concepts and methodologies for the inventive creation of embroidery patterns. In the sphere of art and design, the incorporation of computer-intelligent algorithms has witnessed notable advancements. [8] Machine learning techniques, including neural networks and decision trees, can be used to analyse and understand the features and motifs of artworks, thereby generating new works. The utilization of random forest classifiers for artistic style categorization and generation has facilitated the automated production of artworks. However, existing research primarily concentrates on painting and digital art, with comparatively less focus on the intelligent design of traditional embroidery patterns. [9]

Currently, investigations into the intelligent design of traditional embroidery patterns remain relatively scarce, though some initiatives are beginning to explore this domain. Various proposals have been made for automatically generating and designing embroidery patterns. One such initiative involves a system for embroidery pattern creation based on genetic algorithms, which produces innovative designs through the optimization process inherent in genetic algorithms. [10]. However, these techniques impose constraints on the recognition and extraction of features from pattern elements and lack dedicated algorithmic models tailored to the characteristics of embroidery patterns. Alongside generative design, attention has also been directed towards the analysis and classification of embroidery features. A method for categorizing embroidery patterns utilizing edge detection and texture feature extraction has been suggested. Edge detection algorithms identify geometric attributes, while texture features aid classification. Nonetheless, these techniques face challenges when addressing intricate embroidery patterns, as the interplay between elements and contextual information proves notably complex. In this study, we intend to employ a linear classifier algorithm model to analyze and identify the components of traditional embroidery patterns. The linear classifier algorithm has gained widespread acceptance in machine learning and pattern recognition due to its effective classification and recognition outcomes. By extracting and learning the features of embroidery designs, we will develop a series of classification models and integrate them with optimization algorithms to facilitate innovative embroidery pattern design. In contrast to prior research, our approach will place a stronger emphasis on analyzing and modeling the features of embroidery patterns to enhance their innovation and diversity. In summary, while studies on the innovative design system of traditional embroidery patterns utilizing a computer based linear classifier intelligent algorithm model are still limited, some related efforts have indeed been undertaken in this field.

By employing intelligent algorithms on computers to analyze and learn embroidery designs, we aim to overcome the restrictions of conventional embroidery creation and foster innovation and variety in embroidery styles. This research will have practical importance for advancing and disseminating traditional embroidery artistry.

3. Linear Classifier Class Intelligent Algorithm Model

In the innovative framework for designing traditional embroidery patterns, the creation of the classification algorithm is vital for achieving automatic identification and categorization of designs. Utilizing a linear classifier-based intelligent algorithm model, we can implement machine learning techniques to train the classifier, thus enabling the categorization and identification of embroidery patterns. Prior to developing the classification algorithm, it is essential to preprocess the embroidery pattern data. Initially, the embroidery design must be converted into a format suitable for computer processing. This can be accomplished through image scanning or digital illustration. After initial preparations, including image denoising, enhancement, and cropping, we can extract useful information from the image. However, the complexities arising from variations in voltage levels, transformer capacitance, and other technical parameters make the relationship between solute quantity and concentration in transformer oil intricate, complicating accurate comparisons and analyses of this data. Hence, it is imperative to standardize the samples, calculating their contribution rate within the entire dataset.

$$x_{ii} = x_{ij} / \sum_{j=1}^{d} x_{ij}, \quad i = 1, 2, \cdots, n. \qquad (1)$$

Feature extraction serves as a crucial phase in the formulation of classification algorithms. By deriving features from embroidery patterns, the intricate information of the designs can be converted into numerical characteristics that computers can handle. For embroidery patterns, the following feature types might be considered for extraction: Geometric features, which include the shape, size, edges, and other geometric characteristics of the design; Texture features, which encompass the texture and color distribution of the pattern; and Structural features, which relate to the arrangement and spacing of elements in the design. Various techniques can be applied to extract features for each category. For instance, edge detection methods may be implemented to extract geometric features, texture analysis methods for texture features, and image processing techniques for structural features. Utilizing the Widrow Hoff learning principle, the LMS (Least Mean Squares) algorithm can effectively extract features from the linear model and fine tune the objective function of the model, thereby facilitating successful recognition of the model.

$$\xi(\boldsymbol{W}) = \frac{1}{2}\left(\boldsymbol{e}(n)\right)^2 \qquad (2)$$

In this equation, e(n) denotes the error value during the nth iteration. Once feature extraction is finalized, machine learning algorithms can be applied to train the classifier model. Based on linear computer classifier models, suitable classification algorithms such as Support Vector Machines and Logistic Regression can be selected. These algorithms learn the characteristics and patterns of embroidery designs from the training dataset, enabling the classification and identification of the designs. During classifier training, both a training and a test dataset must be assembled. The training dataset contains pre labeled embroidery pattern samples, each associated with a specific category label. The test dataset is used to assess the classifier's effectiveness and precision. Once the training phase of the classifier is finalized, it is essential to evaluate and refine its performance. Various evaluation metrics can be utilized to gauge the classifier's performance, including accuracy, recall, F1 score, and others. At the same time, the classifier's performance can be enhanced by modifying the parameters of the classification algorithm and the feature selection technique employed. This applies to systems that utilize sliding mode variable structure control.

$$\dot{x} = A_i x + B \ \ y(i = 1, 2, 3 \cdots m) \qquad (3)$$

In this context, we posit that under specific circumstances, a modification in a certain state will trigger a corresponding change at a designated location. Should the alteration at this location take place at a particular point, it will subsequently lead to changes at that position. Here, we need to assume that the adjustment at this position occurs at a specified point and that it transpires at that particular position. Likewise, in this context, we assume that the transformation of this location occurs at a single point, and that the change manifests there. To address the irregularities in the microwave filter ports, we initially employ an enhanced Cauchy method to determine the limiting and residual values of the X parameters. Following this, we utilize the concept of coupling matrices to construct the initial matrix and apply matrix rotation transformation to depict the electrical performance of the filter accurately. Once the classifier's training and evaluation processes are complete, it can be utilized for real world tasks involving embroidery pattern classification and recognition. By feeding the embroidery pattern data to be classified, the classification algorithm can autonomously identify and deliver relevant classification results. In conclusion, by developing suitable classification algorithms, the system for innovating traditional embroidery patterns through computer based linear classifier models can achieve automated classification and recognition of embroidery patterns. Key steps in designing classification algorithms include data preprocessing, feature extraction, classifier training, classifier evaluation, and the classification and recognition of embroidery patterns. Through ongoing optimization of classification algorithm performance, the accuracy and usability of the embroidery pattern innovation design system can be enhanced, thereby aiding the advancement and dissemination of embroidery art.

4. Experimental Design and Analysis

Within the framework of the embroidery traditional pattern innovation design system, the experimental design and analysis aim to assess the performance of classification algorithms and to enhance the system based on the experimental findings. Specific objectives of the experiment include evaluating classification algorithm accuracy, recall, and F1 scores, comparing the effectiveness of various classification algorithms, and fine tuning their parameters and feature selection methods. The phases of experimental design and analysis primarily consist of dataset segmentation, experimental configuration, operational execution, and result evaluation. Embroidery pattern datasets are divided into training and testing subsets to appraise classifier performance better and utilize this data more effectively to boost model accuracy. For the experimental setu-p, it is crucial to select the appropriate classification algorithm and parameter configurations. One can experiment with various classification techniques, such as support vector machines, logistic regression, and others, while fine tuning their related parameters. Additionally, feature selection strategies can be employed to identify the most suitable subset of features. By segmenting the samples based on their features and modifying the relevant experimental parameters, we utilize a specific classification algorithm to examine the interrelations of different attributes within the sample. By statistically evaluating each attribute in the sample, we gain deeper insight into the interactions among them. Our research revealed that various models significantly enhanced the accuracy, recall rate, and F1 score across two distinct datasets.

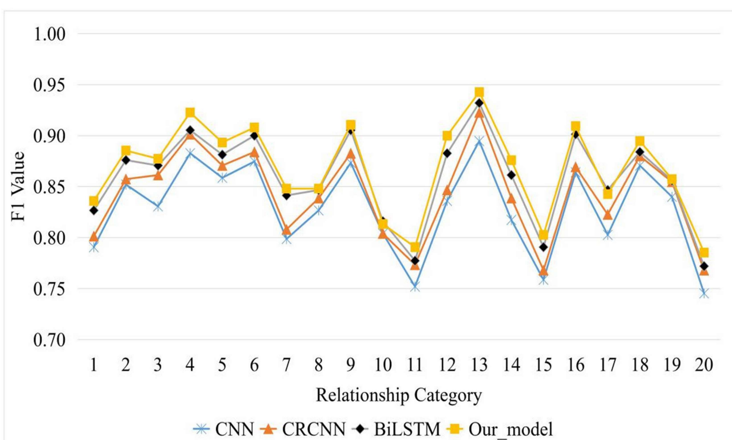

Figure 1. Wiki80 Dataset

Upon analyzing the SemEval dataset, we observed that the association pattern between the fusion words we introduced and other words is considerably stronger than that of other approaches, coupled with a high recall rate. The F1 score curve corroborates these findings. Following extensive research, we discovered that combining the strengths of CNNs and BiLSTMs into a novel framework can significantly improve language identification accuracy, thereby enhancing the model's accuracy, recall rate, and F1 score. Moreover, this framework effectively captures linguistic similarities, enabling better identification and management of complex language scenarios. By integrating two types of independent specialized organics, we can create a new method for association analysis. This technique can leverage data in the corpus to uncover the potential of language through deep learning and linguistic research. It also helps mitigate excessive language consumption, contributing positively to our linguistic studies.

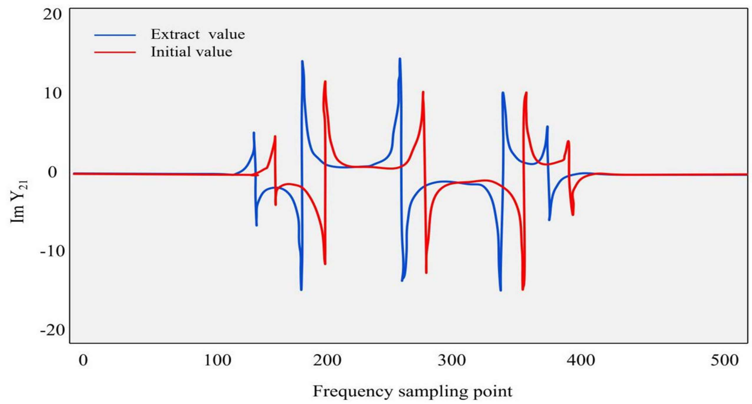

Figure 2. Real and Imaginary Parts of Parameter Y

Based on the extremal and residual values illustrated in Figure 2, we can develop an associative model for the interactions within a six order cavity filter by utilizing the modifications of the resonant and coupling rods, along with the data obtained from them. We implement implicit spatial mapping techniques to draw comparisons with the interactions of the actual filter, aiming for filter optimization. In experimental design and analysis, standard evaluation metrics include accuracy, recall, and F1 scores. Accuracy reflects the ratio of samples accurately categorized by the classifier relative to the total sample count. A higher accuracy indicates superior classifier performance. Recall denotes the ratio of positive samples correctly identified by the classifier from all positive samples, measuring the classifier's effectiveness in recognizing positive instances. The F1 score is a metric that combines accuracy and recall as their harmonic mean. Analyzing and refining based on experimental outcomes is crucial in experimental design and analysis. By assessing the performance of various classification algorithms, one can determine which is most effective. Simultaneously, adjustments to the classification algorithm's parameters and the feature selection approach can be made based on experimental findings to further enhance classifier performance.

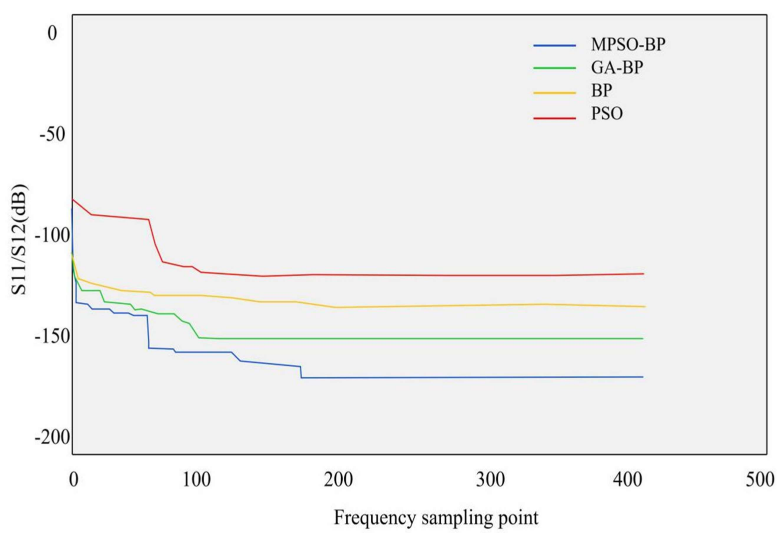

Figure 3. Comparison of Training Errors over Multiple Iterations

Referring to Figure 3, it can be observed that as the iteration count rises, the objective function value markedly declines until it stabilizes. The MACPSO algorithm, through the integration of hybrid optimization, significantly boosts its local solution efficiency, resulting in a rapid convergence rate and effectively discovering superior values. By utilizing the MAS algorithm, the MACPSO algorithm is able to investigate potential features of the agent by comparing the fitness levels of the agent against those of other agents, thus enhancing the intelligence capabilities of the agent. The design and analysis of experiments play a vital role in researching the innovative design system for traditional embroidery patterns within the framework of a computer linear classifier type intelligent algorithm model. Through thoughtful experimental design and result assessment, the performance of the classification algorithm can be reviewed, and the system's design can be fine tuned. Metrics such as accuracy, recall, and F1 scores can be employed to evaluate classifier performance. By analyzing experimental findings, an appropriate classification algorithm can be selected, and the parameters along with feature selection methods can be optimized to enhance the system's accuracy and usability.

5. Conclusion

Utilizing a computer linear classifier type intelligent algorithm model, this research created a pioneering design system for traditional embroidery patterns and performed experimental design and analysis. The following are the findings of this research: The experimental design and analysis play a crucial role in assessing and enhancing the innovative design system for traditional embroidery patterns. By applying a well structured experimental design and analyzing the results, the efficacy of the classification algorithm can be measured, and the system's design can be refined. Throughout the experimental procedure, various stages such as dataset partitioning, experiment configuration, execution, and result evaluation allow for the assessment of metrics like accuracy, recall, F1 scores, and other indicators of the classification algorithm's performance. The findings indicated that different classification algorithms yield varying levels of effectiveness within the innovative design system for traditional embroidery patterns. Based on these results, the most suitable algorithm can be selected, and adjustments to its parameters and feature selection methods can be made as needed to enhance the system's accuracy and functionality. The computer linear classifier type intelligent algorithm model demonstrates significant practicality and effectiveness in the innovative design system for traditional embroidery patterns. Through a well structured experimental design and analysis, its capabilities in classifying and designing embroidery patterns can be uncovered, leading to further optimization of the system's design. In conclusion, this study has established an innovative design system for traditional embroidery patterns based on the computer linear classifier type intelligent algorithm model through experimental design and analysis, while also evaluating and optimizing its performance. The findings offer a novel approach and tool for the classification and design of embroidery patterns, providing valuable insights for research and practical applications in related fields. Future investigations may delve into alternative classification algorithms and models to further improve the system's performance and broaden its applicability.

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