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Saree Classification And Color Change

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ABSTRACT
Sarees are integral to Indian culture and serve as daily attire for most women on the subcontinent. Despite their popularity, there exists a gap in research regarding the automatic segmentation of sarees and the independent color modification of distinct components. Existing methods rely on labor-intensive manual adjustments through commercial applications, impeding productivity and resulting in avoidable expenses. This paper presents a tool that smartly coordinates different deep-learning techniques to modify the color patterns found on different parts of a saree. MODNet is applied for background removal and custom-trained Mask R-CNN models are utilized to precisely segment the saree body and border. The subsequent application of a color-changing algorithm in the HSV color space facilitates independent color modification for the saree border and body. The methodology proposed in this paper can be extended to any kind of clothing such as shirts, trousers, kurtas, kimonos, etc. An accuracy of 93.01% was achieved for the saree border segmentation, and an accuracy of 89.23% was achieved for the saree body segmentation when tested on a set of 50 test images.

1. INTRODUCTION

The rise of artificial intelligence and machine learning has transformed various industries, including the traditional Indian clothing sector, which offers significant opportunities for automation and modernization. Despite its cultural importance, the saree market lacks innovation, relying on time-consuming tools like Photoshop for design and visualization. To address this, we propose an intuitive software tool for automated saree design and virtual visualization.

The saree, a single-piece traditional Indian garment, consists of a main body and ornate borders. Currently, no automated methods exist for detecting and customizing saree components. This study presents a methodology using deep learning to identify saree elements and enable color customization through background removal, image segmentation, and pixel manipulation in the HSV color space.

Background removal enhances segmentation accuracy by eliminating noise. Techniques like defocused image segmentation [2], which builds on PCNN and LBP frameworks [3], show improved precision by leveraging image blur. Alternatively, MODNet architecture [4] effectively detects backgrounds without blur, combining trimap-free matting and trimap-grounded matting.

For detecting saree components, traditional methods such as color-based thresholding [5], edge detection, and contour-based techniques [6] face issues with lighting sensitivity and manual tuning. This study employs peak hue extraction in HSV space combined with Mask R-CNN [9] for enhanced accuracy. The HSV color space [11], [12], [13] enables effective color alteration while preserving contrast and saturation. Our approach also improves upon existing techniques [14] by facilitating simultaneous color modification of multiple elements.

2-LITERATURE REVIEW

Advancements in Artificial Intelligence (AI) have revolutionized the fashion industry, enabling tasks such as fabric classification, pattern recognition, and color customization. Convolutional Neural Networks (CNNs) have demonstrated high accuracy in identifying intricate textile patterns, while Generative Adversarial Networks (GANs) enable seamless color transformations, preserving texture and detail. For saree-specific applications, pattern recognition plays a crucial role in identifying traditional motifs like floral, geometric, paisley, and abstract designs, reflecting cultural and regional identities. Additionally, AI-driven tools like virtual try-ons and dynamic sizing algorithms enhance the customer experience by offering personalized recommendations and accurate fit predictions, addressing common challenges in online retail. These advancements help manufacturers remain competitive by expanding product offerings, optimizing workflows, and reducing production costs.

This research builds on these trends by focusing on the unique challenges of saree classification and customization. Deep learning models such as Faster R-CNN and Mask R-CNN are employed for precise pattern classification and component segmentation, enabling automated identification and processing of saree designs. Additionally, real-time color customization using HSV color space transformations provides users with greater control over design preferences, bridging traditional artistry with modern technology. By integrating these innovations, the proposed system not only enhances product personalization but also supports the cultural preservation of saree craftsmanship, delivering a novel and practical solution for both manufacturers and consumers in the saree industry.

3-DESIGN

Development Platforms

The development of the saree classification and color customization tool utilized Python 3.9 along with TensorFlow, OpenCV, and MODNet. These platforms and models were selected for their capabilities in image processing, deep learning, and real-time background removal. The development process also employed Mask R-CNN for segmentation tasks and Faster R-CNN for human detection. The primary libraries used are:

Python: Core language for algorithm development and image processing. TensorFlow: Deep learning framework for model training.

OpenCV: Library for image processing tasks, including conversion to HSV color space. MODNet: Used for efficient and robust background removal.

Mask R-CNN: For precise segmentation of saree body and border. Faster R-CNN: For detecting humans in the input images.

List the development platforms and their purposes given in below table:

Platform/Library	Version	Purpose
Python	3.9	Core programming language
TensorFlow	2.9	Deep learning model development
OpenCV	4.5	Image processing and conversion to HSV
MODNet	Latest	Background removal
Mask R-CNN	Custom-trained	Segmenting saree components
Faster R-CNN	Custom-trained	Human detection in images

System Design

The system is designed to automate the classification and color-changing process of saree components using deep learning techniques. The process is divided into three key stages: classification, segmentation, and color transformation. The system architecture integrates these stages seamlessly to provide an end-to-end solution.

System Architecture

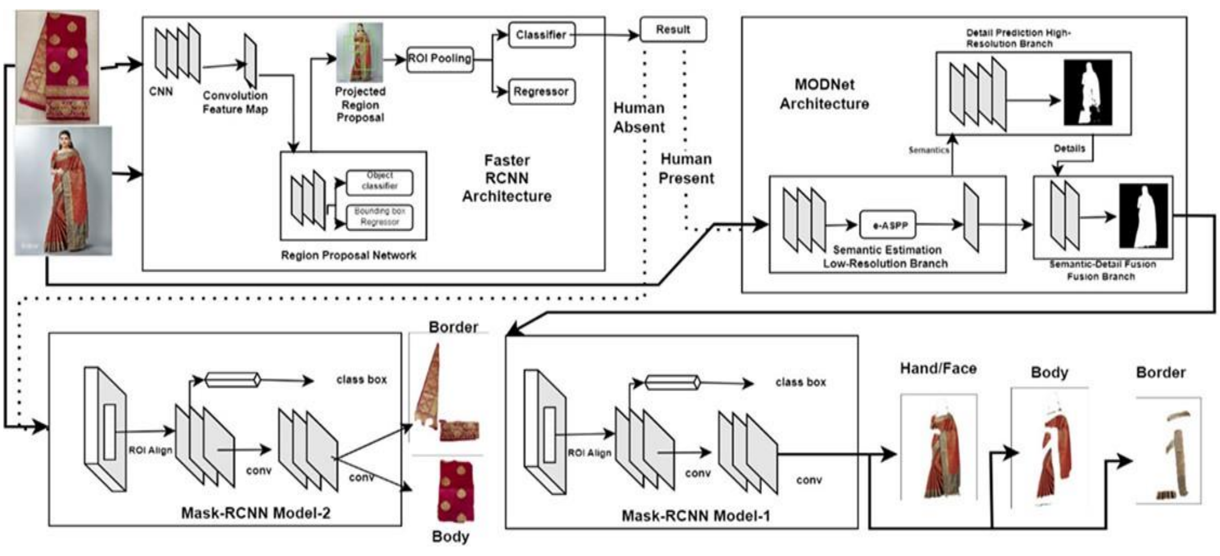
The architecture involves a pipeline where each model contributes to the final output:

Input Image: A user uploads a saree image for processing.

Classification: Faster R-CNN is used to classify saree components such as the body, pallu, and border.

Segmentation: Mask R-CNN performs precise segmentation for each component.

Color Change: The segmented saree components are manipulated using the HSV color space to change the color.



3-METHODOLOGY

The proposed methodology mainly consists of selecting the pixels related to different saree components and then recoloring them. To enable this, a combination of background removal technologies and semantic segmentation techniques are utilized. The HSV color space is adopted for recoloring the image. This section briefly explains the current advancements in background removal, image segmentation, and huemanipulation technologies.

Proposed Methodologies

The proposed tool consists of three phases:

- Human detection
- Background removal
- Recoloring phase

4-RESULTS

A test set of 50 images was prepared to evaluate the performance of the saree image classification, segmentation, and color modification system. The images represented various saree varieties and were annotated using the Make Sense AI annotation tool to identify the saree body and border regions. These annotated labels served as the ground truth for comparison with the system's output.

Pixel Classification Performance

The proposed method was tested on annotated images, classifying pixels for the saree body and border. The results were compared with manual annotations using a confusion matrix. The method outperformed state-of-the-art techniques, BiSeNetV2 and DeepLabV3, in accuracy, precision, recall, and F1 score.

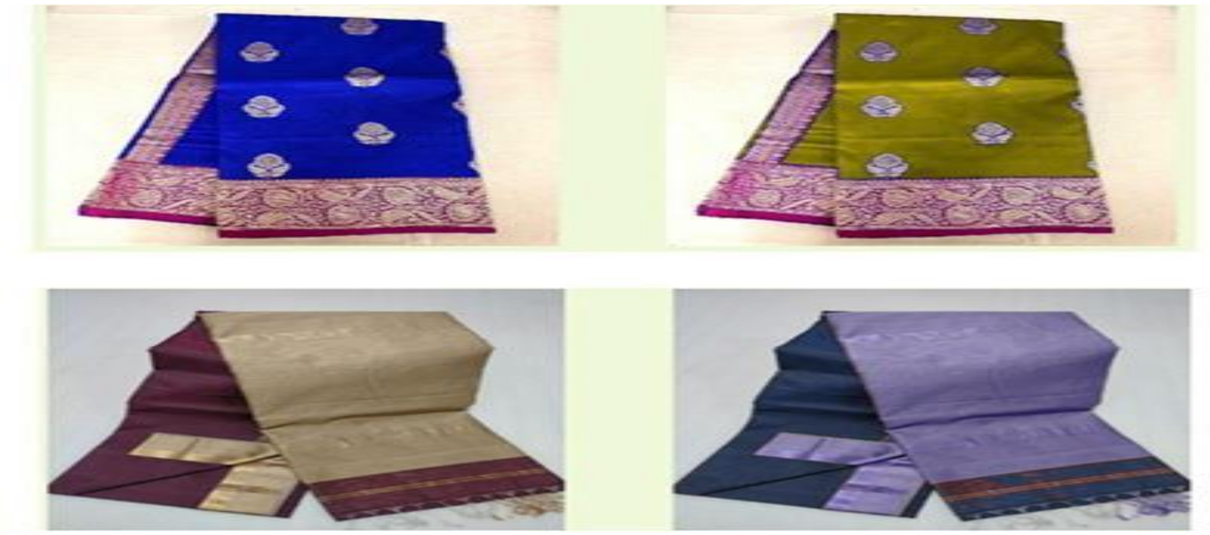
- **Saree Body Classification:** Achieved 93.01% accuracy.
- **Saree Border Classification:** Achieved 89.23% accuracy.

Color Customization Performance

Accuracy vs Color Dominance: The accuracy of color customization was influenced by the degree of color dominance in the saree images, assessed via hue histograms. Background elements and skin tones were treated as noise and removed. The combined use of MODNet, Faster R-CNN, and Mask R-CNN provided stable and higher accuracy in color manipulation, particularly in images with humans.

Results for Folded Sarees and Sarees with Humans

Figure 4.3.1: Shows the output for folded sarees after applying the proposed methodology, with the original image on the left and the color-modified image on the right.



Displays the output for sarees worn by humans, where the system was able to adjust the saree's color while maintaining the integrity of the human presence.

The resultant images with humans wearing saree (right) obtained from running the architecture on the original images (left).

Comparison with State-of-the-Art Methods

The performance of the proposed method was compared with two leading semantic segmentation techniques: **BiSeNetV2** and **DeepLabV3**. The results show that the proposed method significantly outperforms these state-of-the-art techniques in terms of pixel classification accuracy for both the **saree body** and **border**. The proposed method achieved an accuracy of **93.01%** for the saree body and **89.23%** for the saree border, surpassing the other techniques. This superior performance can be attributed to the combination of **MODNet** for background removal, Faster **R-CNN** for image classification, and **Mask R-CNN** for precise pixel segmentation, which collectively enhanced the accuracy.

5-CONCLUSION

In this study, an attempt is made to automate the color-changing process of individual parts of a saree. Manually selecting the desired areas and modifying the colors using photo editors requires considerable effort and software expertise. The proposed algorithm performs the same task within nine seconds and with minimum effort from the user. This method also helps retailers visualize the same saree with different colors to decide the best color combination before manufacturing. It seeks to tap into the ocean of complex traditional designs and introduce a spark of intelligence to the current system.

The methodology integrates Faster R-CNN for classification, Mask R-CNN for semantic segmentation, and HSV-based color swapping. When evaluated on 50 test images, it achieved an accuracy of 93.01% in detecting saree borders and an accuracy of 89.23% accuracy in identifying saree body regions, outperforming other state-of-the-art techniques for saree body and border detection.

The effectiveness of the suggested approach diminishes when applied to images featuring unconventional postures. Enhancements could be achieved by training the model on a more expansive and diverse dataset. The proposed methodology encounters challenges when dealing with sarees that exhibit iridescence, like silk sarees. The extensive range of colors in such sarees results in a substantial loss of details when subjected to color modifications. Additionally, the methodology has the potential to expand its capabilities beyond color alteration, allowing for the incorporation of diverse patterns onto the saree. The approach suggested in this study can be expanded to encompass various types of apparel, such as blouses, pants, kurtas, and kimonos.

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