Recommendation of Fashion Cloths Using Machine Learning Model

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Abstract: **Color compatibility is the essence of fashion and dress selection, not only determining the beauty of an outfit but also determining consumer purchasing behavior. Following the significance of visually pleasing and harmonious garments, this study develops a deep learning-based system for color categorization and fashion suggestion automatically. Its main goal is to intelligently pair shirts with similar bottomwear based on established color theory principles to improve user experience in fashion use cases like virtual try-ons, personal shopping assistants, and e-commerce.**

Its core is a Convolutional Neural Network (CNN) architecture built with TensorFlow that can classify shirts into pre-defined color classes from images. These are basic colors like Red, Black, White, Yellow, and Pink. The CNN model is trained and tested on specially preprocessed data, split into labeled directories, stored in ZIP archive format. Data includes high-resolution images of bottomwear and shirts colored. In order to have better generalization and stability, the images are preprocessed through the use of the Keras ImageDataGenerator class that performs a sequence of augmentation operations such as rotation, scaling, shearing, and flipping in addition to normalization.

The model, having been trained, is very efficient in multi-class classification and can correctly classify the color of the input shirt image. Classification leads to a rule-based color pair engine producing esthetically balanced bottomwear recommendations. The engine relies on a database of traditional and modern color harmony rules of color theory—complementary, analogous, triadic, and split-complementary relations—to recommend colors for bottomwear with greater aesthetic balance and contrast.

For the effective retrieval and output of suggested products, there exists a tidy CSV metadata file within the process. A file of this type will have one record per article of clothing with the correct attributes including article type, color tag, and image file path. Pandas library is utilized to read this metadata, and filtering the relevant bottomwear option according to color rules of compatibility is also done by it. Lastly, the chosen recommendation is shown graphically to the user using OpenCV for image processing and Matplotlib for layout visualization, thus adding to a collaborative visual and user-friendly system of recommendation.

This solution leverages both the capabilities of deep learning and rule-based reasoning to provide a scalable and intelligent personalized fashion recommendation solution. Future research can investigate extending the application of user preference, garment type, seasonal fashion trend, and texture analysis to further improve the quality and flexibility of recommendations across different categories of fashion.

I. INTRODUCTION

Fashion changes at a faster rate as artificial intelligence and computer vision functionality are coming together more and more. Among the most crucial aspects affecting styling for people as well as picking outfits is being color compatible with other people, having a make-or-break influence on beauty as well as attractiveness while shopping. With the future online shopping sites and virtual dressing rooms, there comes extra need for intelligent systems which would help customers to choose optimally appearing ensembles of dresses. This article fills in this gap by coming up with an AI pipeline which determines the color of an apparel (shirt) and suggests bottomwear with color that will go well with the shirt.

The conventional fashion recommendation mechanisms are usually user rating, purchase history, or manually labeled attributes-based, and these are not scalable and do not support real-time visual inspection. In contrast, the proposed work employs deep learning-based image classification for detecting the most prominent color of a shirt from an image and suggesting bottomwear items based on principles of color harmony developed. The

automation minimizes reliance on human labeling and maximizes personalization of fashion recommendations.

The brain of the system is a Convolutional Neural Network (CNN) that has been trained on a dedicated dataset of images of shirts and bottoms, color-labeled. TensorFlow's ImageDataGenerator preprocessed and augmented the data so that the model could learn to generalize across lighting and texture variations. When trained, the model classifies an inputted shirt image as a given color class. A pre-calculated color pair dictionary is then used to project the resulting color onto a list of acceptable bottomwear colors based on standard color-matching techniques in the fashion world.

To obtain proper recommendations, the system loads a CSV metadata file with URLs of images and labels of bottomwear items. The identified bottomwear items are displayed visually with OpenCV and Matplotlib, thus closing the loop of recommendation. It is an interdisciplinary collaboration of machine learning and domain knowledge that renders the solution feasible for improving clothing selection in digital wardrobes, virtual try-on applications, and online stores.

II. LITERATURE SURVEY

III. PROPOSED METHOD

The proposed methodology combines fashion color theory and deep learning in developing an efficient and scalable system for recommending shirts.

Following are the steps:
1. User input: Posting the image of the shirt.
2.Preprocessing: Image resizing and normalization for passing it to the CNN model.
3.Color Classification: Identification of the dominant shirt color based on visual features learned by the model.
4. Color Mapping: The forecasted color is color-mapped into a list of suggested bottomwear colors from a pre-defined fashion design dictionary.
5. Metadata SHALL: Bottomwear products are fetched from a CSV metadata file for article type and color.
6. Image Retrieval and Display: OpenCV and Matplotlib are employed in the system for image retrieval and display of matching bottomwear images, finalizing the recommendation process.

IV.METHODOLOGY

The general objective of this study is to develop a system based on deep learning to analyze an image of a shirt to identify its color and recommend bottom pieces visually matching based on color pair principles developed on color theory principles. The procedure is structured into a series of core steps, starting with the preparation of datasets, where a custom image dataset of shirts and lower-wear pieces is set in color class labeled directories such as Red, Blue, White, Black, and Yellow.

All images are annotated with metadata, i.e., article type, color label, and file path, stored in an ordered CSV file for simplicity of retrieval and access. For robustness and generalizability purposes, images are preprocessed using Keras's ImageDataGenerator that includes normalization and data augmentation processes such as rotation, flipping, and zooming. Designing and training the model as step two involves employing a Convolutional Neural Network (CNN) based on TensorFlow and Keras. Design includes a number of layers of convolution and pooling followed by fully connected layers and softmax output layer for multi-class classification. The model is also trained on preprocessed shirt images with categorical cross-entropy as the loss function and accuracy as the best evaluation metric.

After training, the model can select the most unique shirt color from the input image by outputting the most probable color class. Once classified, the system proceeds to the recommendation stage, wherein a pre-established dictionary of color pairs—after complementary, analogous, and other color harmony patterns—is used to suggest suitable bottomwear colors. The system next screens bottomwear images from the database according to color compatibility rules and returns corresponding items for the query based on the metadata retained in the CSV file. Finally, the recommended suggestions are presented to the user graphically using OpenCV and Matplotlib and form an intelligent and interactive fashion suggesting system based on rule-based decision-making fused with deep learning.

V. RESULT

AUTHOR	STUDY/ REFERENCE	TECHNOLOGY/ METHOD	KEY FINDINGS/ CONTRIBUTIONS	RELEVANCE TO PROJECTS
1)Redmon et al. (2016)	YOLO (You Only Look Once), a groundbreaking real-time object detection system that redefined how images are processed by neural networks. Unlike traditional methods that repurpose classifiers to perform detection, YOLO treats object detection as a single regression problem, predicting bounding boxes and class probabilities directly from full images in one evaluation.	Deep Learning, CNN, Collaborative Filtering	Introduces YOLO for real-time object detection, achieving high accuracy and speed for detecting objects in images.	YOLO serves as the basis of the project for detecting and classifying clothing items to suggest complementary fashion pieces.
2) Liu et al. (2017)	FashionNet, a deep learning-based fashion recognition system designed to automatically understand and categorize fashion images. The model integrates multiple convolutional neural networks (CNNs) to jointly predict clothing attributes, landmarks, and compatibility between garments.	Deep Learning, CNN, FashionNet	Proposes a model to understand fashion images, extracting visual features for automatic categorization and recommendations.	Directly relevant to the project's aim of fashion categorization using deep learning models like YOLO for recognizing clothing and understanding styles.
3) Zhang et al. (2018)	the application of deep learning techniques for personalized fashion recommendation, emphasizing the use of Convolutional Neural Networks (CNNs) to analyze visual features of clothing.	Deep Learning, CNN, Collaborative Filtering.	Investigates deep learning for fashion recommendations, focusing on CNN models to understand fashion preferences.	Utilizes deep learning for fashion recommendations, similar to the project's goal of using AI for personalized fashion guidance.
4)Song et al. (2019)	a personalized fashion recommendation framework that integrates user preferences with visual clothing styles. Their approach combines user behavior data with visual features of fashion items to enhance recommendation accuracy.	Computer Vision, Collaborative Filtering	Combines computer vision with user preference modeling to offer personalized fashion recommendations.	Aligns with the project's aim to provide fashion advice based on individual preferences and style, combining visual analysis and user-centric data.
5) Li et al. (2020)	a comprehensive survey on the application of deep learning techniques in fashion recommendation systems. Their work highlights how advanced models—such as convolutional neural networks (CNNs), generative adversarial networks (GANs), and transformer architectures—are	Deep Learning, Neural Networks, Fashion Recommender Systems	A comprehensive review of various deep learning techniques for fashion recommendation, including CNNs and GANs.	Summarizes state-of-the-art methods that inform the project's use of deep learning algorithms to offer

	employed to enhance personalization and aesthetic understanding in fashion recommendations			personalized and data-driven fashion recommendations
6) Bochkovskiy et al. (2020)	YOLOv4, a significant advancement in real-time object detection that balances speed and accuracy for practical deployment. Building upon YOLOv3, YOLOv4 incorporates several enhancements such as WeightedResidual Connections (WRC), Cross-Stage Partial connections (CSP), Cross mini-Batch Normalization (CmBN), Self-Adversarial Training (SAT), and Mish activation	YOLOv4, Object Detection	YOLOv4 improves upon the original YOLO model with faster and more accurate object detection in real-time applications.	Offers an updated and refined version of YOLO that could improve the accuracy and speed of the object detection model used in the fashion recommendation system.
7)Zhou et al. (2021)	an interactive fashion recommendation system that leverages machine learning to align product suggestions with individual user preferences. By integrating visual features of clothing items with user interaction data, the system offers personalized recommendations that resonate with users' unique styles.	Machine Learning, User Interaction, Fashion Recommendation	Explores the integration of user interaction and machine learning to enhance fashion recommendation systems.	Relevant to the project's interactive nature, where user uploads and preferences drive personalized recommendations.

Input:

```
# Load shirt image
shirt_path = "D:\intership\Colours_based_dataset\Colors\Red\Rs\Rs5.jpeg"
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 235ms/step
Predicted color: Red
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Output:

Recommended Bottomwear: Yellow

VI. CONCLUSION

This research outlines a deep learning approach to automatic color categorization of shirts and color-coordinated bottomwear proposals generation. Leveraging domain expertise in fashion color combination into Convolutional Neural Networks (CNNs) enables the system to provide an efficient and scalable solution towards smart outfit matching. Training and cross-validation of the model successfully using a structured, color-tagged dataset, with a rule-based color pair dictionary providing suggestions aligned with traditional sense of fashion. The pipeline—ranging from image preprocessing to CNN-based color forecasting to bottomwear suggestion via CSV metadata—illustrates a synergistic combination of knowledge-based reasoning and computer vision. The visual system outputs also play a part in the practical applications of the system in virtual try-ons, styling assistants, and e-commerce recommenders.

Although color is emphasized here as the major characteristic for coordinate fashion in the existing solution, in future efforts it can be fascinating to look at other characteristics like texture, pattern, garments type, and even personal preference too in order to enable better quality of recommendation. Also, real-time usage and user accessibility through a web or mobile client would offer greater adoption and ease.

VIII.REFERENCES

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