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FASHION ACCESSORY RECOMMENDATION SYSTEM

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Abstract
This research focuses on the development of an AI-powered system that helps people choose accessories that match their outfit and enhance outfit coordination by analyzing the dominant color in the fabric image. The system uses advanced color extraction to analyze the main shades in fabric and generates accessory suggestions that complement with the analyzed colors. It also integrates current fashion trend insights, such as geometric patterns and earthly tones, to make stylish and trendy recommendations suitable for fashion designers, stylists, and consumers.
This AI-driven approach blends fashion and technology, helping users create well-coordinated outfits that align with modern styling trends. Issues like complexities in text-to-image development process and accessibility of data are encountered. In coming time improvements includes making bigger dataset to get more colors patterns and textures, good-tuning models for fashion targeting tasks, developing automated testing frameworks for accessory matching. The model holds energy for development into e-commerce platforms, individual styling applications and fashion suggestion systems, giving personalized and dynamic fashion solutions.
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Keywords: Accessory Recommendation; Color Extraction; Fabric Analysis; Fashion AI; Outfit Coordination; Machine Learning; Styling Solutions; Image Processing

1. INTRODUCTION

There is no doubt on the impact of fashion in defining social identity and shaping personal expression. We see a crucial impact of fashion, especially coordinated style fashion getting popular in recent years, accessories play crucial part in enhancing the entire look of the person. Accessories like purses, shoes, and jewelry not only enhance the look but also give a reason to flex and show off among people. After the rise of fast fashion, there is a dire need for sophisticated technologies to make visually appealing outfits effortlessly.

Fast Fashion has revolutionized fashion business after the rise of Artificial Intelligence and computer vision. AI engines are now able to help identifying design aspects, analyze user likes and preferences and enhance fashion choices by providing tailored recommendation.

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By the help of input photographs, researchers and engineers have curated methods that creates (LLMs) Large Language Models Like ChatGpt and Models like (YOLO) You Only Look Once based on deep learning models. (Jocher et al., 2023) (OpenAI et al., 2023).

One of the main focus of current AI based fashion recommendation systems is targeting apparel detection and classification (Liu et al., n.d.) (Ge et al., n.d.). Morley there is plenty of room in studies related to selection of accessories based on color and design of fabric, knowing how important accessories are to make an ordinary looking cloth piece into a masterpiece (Kalinin et al., 2024). The gap that this study is trying to grip is extracting dominating colors of photos of fabrics and picking suitable accessories. The aim is to give stylish solutions to every fabric provided.

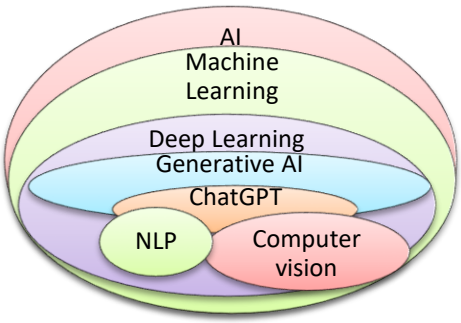

Fig.1. The diagram shows AI domains, including Natural Language Processing, Machine Learning, computer vision, Deep Learning, Artificial General Intelligence, and Model like ChatGpt.

2. RELATED WORK

In modern year, fashion AI models has made remarkable progress for analyzing, also using modern and leading machine learning models generative AI to give customized style recommendation. Literature review section concern image processing, color extraction, style recommendation accessories coordination.

2.1. Image Analysis and Fashion Detection

Customized personal fashion recommendation, exact fashion selection is difficult. The YOLO (You Only Look Once) is process to help you in real time objection detection. YOLOv8 like recent AI development have renowned conventional creative design for selecting and identifying fashion elements (Bochkovskiy et al., 2020) (Jocher et al., 2023). (Kalinin et al., 2024) use of YOLOv8 for fashion segregation and identifying items, which helps the correct selection of clothing components such as jackets, shirts, and shoes.

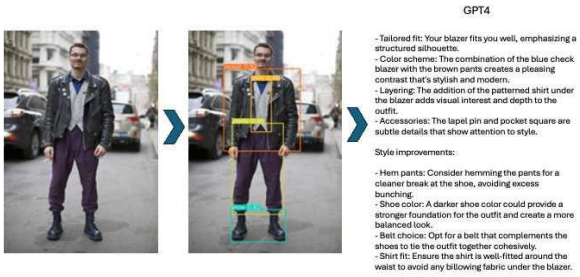

Fig.2. Yolo V8, and GPT-4.0 Vision-based fashion advisor for personal assistance.

2.2. Color Extraction and Clustering Techniques

Color is necessary for fashion suggestions, and mass algorithms like K-Means have manifested high potential in picking dominant colors. K-Means clustering is generally working to segment image information into symbolic clusters demanding on pixel color values (Jain & Dubes, 1988). literature review shows that K-Means can be recommended for use in fashion activities, which will be permitted to the systems to recommend color schemes and accessories and customized clothing (Li et al., 2025)(Malhi et al., n.d.). In this research, dominant colors were extracted from fabric images using K-Means (n-clusters=5), this served as the base for accessory proposal.

Fig.3. K-Means clustering applied for color segments division of original fabric image into color clusters.

2.3. Style and Accessory Recommendations

It is now feasible to offer detailed and tailored style advice thanks to generative AI models. Out of open AI series the GPT has evidenced its capability to produced collective and visionary hints (OpenAI et al., 2023). Incorporated GPT-4 to provide fashion implication customized to identifying clothing items (Kalinin et al., 2024). In this study, Modern style preferences, dominant colors, and aesthetics recommendation GPT-4 was used to create helpful hints.

2.4. Text-to-Image Fashion Generation

The access of modern text-to-image generation AI models has provided visual tools for examining fashion suggestions. Literature references Hugging Face's FLUX.1-dev model, which gives great quality images from textual descriptions

(Hugging Face Team, 2023) (Wang et al., n.d.). The purpose of this study is to visualize shalwar kameez styles as well as recommended accessories in order to provide a more comprehensive concepts of stylistic.

2.5. Evaluation Metrics

Several evaluation metrics are used to examine the AI-driven systems (Liu et al., n.d.)(Hong et al., 2018):

Clustering Performance: It is visually evaluating process to understand the quality of segregated highlighted colors.

Accessory Relevance: A subjective assessment that focuses on the harmony of colors and how well they align with current trends. The relevance of accessories to current trends of measured by their harmony and a lining them with latest trends.

Image Generation Quality: the degree to which the images are generated, and in devotion to the prompts. This review synthesizes insights from these studies, emphasizing the vital role of clustering techniques, generative models, and data-driven insights in enhancing personalized fashion accessory recommendation systems. The research demonstrates the promise of integrating machine learning algorithms to achieve outcomes that are both more accurate and visually appealing, paving the way for future advancements in the fashion industry.

3. PROPOSED METHODOLOGY

3.1. Research Objectives

The aim of this study is to implement and create a system for accessory recommendation that extracts dominant colors from the fabrics and then utilizes them for the appropriate accessory suggestions. The main motive of this system is to produce the outcomes that shows the fashionable and harmonized accessory suggestions for each of the fabric type.

3.2. Research Design

The research combines the image processing, clustering methods, doctrines of color coordination, and recommendation system, it employs the computational and the data-centric tactics to attain its objectives. This tactic contains three important phases: image processing and extraction of the colors, developing the algorithm of recommendation and systems evaluation.

3.3. Data Collection

The dataset is consists of images of high-resolution fabric that demonstrates diverse kind of textures, patterns and colors. The images of this dataset is collected from a various range of knitted fabric, shiny cloth and textured surfaces. Furthermore the dataset features following fabric colors.

1. Details of shiny fabric
2. Yellow textured surface
3. Colorful knitted fabric
4. Neutral textile
5. Green abstract cloth
6. Smooth, stylish blue fabric
7. Textured backdrop

3.4. Data Preprocessing

The following processes were applied to assure the exact and reliable outcomes during image processing:

Image resizing: In this process the images of the fabric were resized to standardized size 224*224 pixels.

Normalization: Is the process of scaling the values of image pixels to a specific range to improve the performance and stability of the model, image were normalized with mean of [0.485, 0.456, 0.406] and the standard deviation of [0.229, 0.224, 0.225].

Transformation tools: These preprocessing transformations were implied using the torchvision.transforms module from PyTorch which provides the verity of image transformation functions.

Color space conversion: Is the process of transforming the image from one color representation to other to improve the perceptual color discrimination. The images were converted from RGB color to LAB color space.

Noise reduction: the image noise was removed by using the Gaussian filter and also facilitated dominant color identification.

3.5. Color Extraction Technique

For the extraction of the color for each fabric image, following methods were applied:

K-Means Clustering: machine learning algorithm used to partition a dataset into k distinct clusters, k=5 to determine five dominant color clusters in each image.

Color Quantization: Is technique used to reduce the number of distinct color images the centroid of each cluster was selected as a representative color.

Color format standardization: ensures consistency in color representation the retrieved colors were converted into HEX codes to confirm the compatibility with the accessory mapping system.

3.6. Accessory Recommendation Model

In this process the accessory recommendation system was created on the basis of color coordination principles and fashion dexterity:

Accessory Categorization: in this section the accessory was characterized into six-types which are shoes, handbag, scarves, hats, belts and jewelry.

Color Harmony Rules: suggestions were given by applying the color coordination principles likewise triadic color patterns, analogous and complementary.

Heuristic algorithm: To match the extracted fabric colors with the accessory color palettes rule-based algorithm is used to ensure the attractive and stylish combination.

Implementation tools: by utilizing data structure and empirical mappings the recommendation system framework was executed in python.

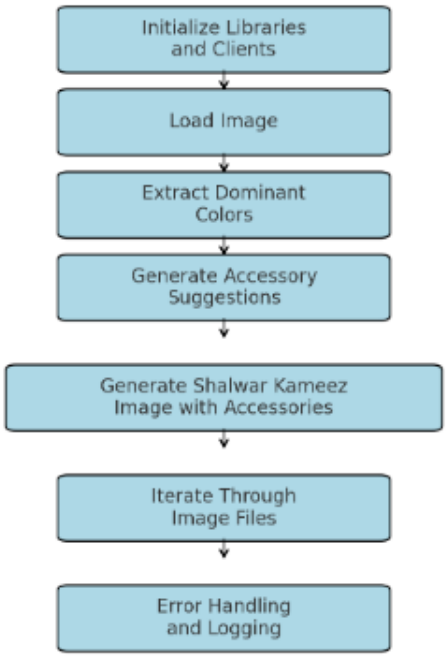

Fig.1. Flow chart of proposed model

4. IMPLEMENTATIONS

4.1. Model Details

EfficientNet B0: EfficientNet models are known for the accuracy and efficiency Pre-trained on ImageNet which is used for feature extraction to process input images.

KMeans Clustering: Parameters: n_clusters=5, the algorithms will group the data into 5 clusters, random_state=0, ensures the reproducibility by initializing algorithms with affixed random seed.

OpenAI GPT-4: API for generating accessory suggestions, based in fabric images integrated it with recommendation system.

Hugging Face FLUX.1-dev: Experimental model used for generation of fashion images from dynamic and efficient text description

4.2. Evaluation Metrics

Accessory Relevance: Accessory suggestions could be subjectively evaluated based on color coordination and trend relevance.

Image Generation Quality: image generation quality is assessed by intelligibility, design consistency, and observance to the prompt. High quality images maintain realism.

4.3. Validation

Accessory suggestions were validated for correctness as follows:

Accessory Suggestions for Shiny fabric details:

Earrings: Gold hoop earrings with amethyst stones. ✅

Necklaces: A silver layered chain necklace with a deep purple pendant. ✅

Handbags: A structured black leather handbag with rose gold accents. ✅

Shoes: Pointed-toe ankle boots in deep plum suede. ✅

Bracelets: Thick bangle bracelets in matte gold and leather. ✅

Belts: A wide belt in soft taupe with a gold buckle. ✅

Scarves: A lightweight patterned scarf with shades of lavender and cream. ✅

Accessory Suggestions for Yellow textured surface:

Earrings: Gold hoop earrings with turquoise enamel inlay ☑

Necklace: Layered gold chain necklace with a green jade pendant ☑

Handbag: Black leather crossbody with gold hardware ☑

Shoes: White ankle boots with a chunky heel ☑

Bracelets: Stackable bracelets in coral and rose gold ☑

Belt: Thin black leather belt with a statement gold buckle ☑

Scarf: Printed silk scarf featuring a mix of deep navy and mustard patterns ☑

Accessory Suggestions for Colorful knitted fabric:

Earrings: Gold hoop earrings with red enamel accents ☑

Necklaces: Layered gold necklace with geometric pendants in white and orange ☑

Handbags: Structured beige tote with a pop of rust-colored detailing ☑

Shoes: Strappy nude block heel sandals ☑

Bracelets: Stacked bangles in rose gold and coral ☑

Belts: Wide black belt with a bold golden buckle ☑

Scarves: Lightweight silk scarf featuring a mix of blush pink and burnt orange patterns ☑

Accessory Suggestions for Neutral textile:

Earrings: Gold hoop earrings with ruby red enamel detailing. ☑

Necklaces: Layered gold chain necklace with garnet and ruby pendants. ☑

Handbags: Black faux leather crossbody with gold accents. ☑

Shoes: Nude block heel sandals with a touch of metallic sheen. ☑

Bracelets: Stacked bangles in gold, burgundy, and a touch of peach. ☑

Belts: Wide black suede belt with a large statement gold buckle. ☑

Scarves: Lightweight silk scarf in black and white abstract print with hints of burgundy. ☑

5. Testing and Results

5.1. Results

Dominant Colors: Extracted accurately and visualized alongside original images.

Accessory Suggestions: Generated trendy and complementary items for all styles tested (e.g., modern).

Screenshot 1:

Accessory Suggestions for /close-up-shiny-fabric-details.jpg: 1. Earrings: Gold hoop earrings with amethyst stones.
2. Necklaces: A silver layered chain necklace with a deep purple pendant.
3. Handbags: A structured black leather handbag with rose gold accents.
4. Shoes: Pointed-toe ankle boots in deep plum suede.
5. Bracelets: Thick bangle bracelets in matte gold and leather.
6. Belts: A wide belt in soft taupe with a gold buckle.
7. Scarves: A lightweight patterned scarf with shades of lavender and cream.

Screenshot 2:

Accessory Suggestions for /close-up-yellow-textured-surface.jpg: 1. Earrings: Gold hoop earrings with turquoise enamel inlay
2. Necklace: Layered gold chain necklace with a green jade pendant
3. Handbag: Black leather crossbody with gold hardware
4. Shoes: White ankle boots with a chunky heel
5. Bracelets: Stackable bracelets in coral and rose gold
6. Belt: Thin black leather belt with a statement gold buckle
7. Scarf: Printed silk scarf featuring a mix of deep navy and mustard patterns

Screenshot 3:

Accessory Suggestions for /colorful-knitted-fabric-background.jpg: 1. Earrings: Gold hoop earrings with red enamel accents
2. Necklaces: Layered gold necklace with geometric pendants in white and orange
3. Handbags: Structured beige tote with a pop of rust-colored detailing
4. Shoes: Strappy nude block heel sandals
5. Bracelets: Stacked bangles in rose gold and coral
6. Belts: Wide black belt with a bold golden buckle
7. Scarves: Lightweight silk scarf featuring a mix of blush pink and burnt orange patterns

Screenshot 4:

Accessory Suggestions for /flat-lay-textile.jpg: 1. Earrings: Gold hoop earrings with ruby red enamel detailing.
2. Necklaces: Layered gold chain necklace with garnet and ruby pendants.
3. Handbags: Black faux leather crossbody with gold accents.
4. Shoes: Nude block heel sandals with a touch of metallic sheen.
5. Bracelets: Stacked bangles in gold, burgundy, and a touch of peach.
6. Belts: Wide black suede belt with a large statement gold buckle.
7. Scarves: Lightweight silk scarf in black and white abstract print with hints of burgundy.

Screenshot 5:

Accessory Suggestions for /green-abstract-cloth.jpg: 1. Earrings: Gold hoop earrings with emerald green stones
2. Necklaces: Layered gold chains with a deep green pendant
3. Handbags: A structured white faux leather handbag
4. Shoes: Nude block-heeled sandals
5. Bracelets: A stack of mixed metal bangles with green accents
6. Belts: A woven tan leather belt
7. Scarves: A lightweight silk scarf with a floral print that incorporates pink and coral tones

Screenshot 6:

Accessory Suggestions for /smooth-elegant-blue-fabric-material-texture.jpg: 1. Earrings: Gold geometric drop earrings
2. Necklaces: Layered silver chain necklace with ocean blue pendant
3. Handbags: White crossbody bag with gold hardware
4. Shoes: Light grey ankle boots with a block heel
5. Bracelets: Turquoise beaded stackable bracelets
6. Belts: Navy blue wide belt with a sleek gold buckle
7. Scarves: Patterned silk scarf featuring light blues and soft creams

Screenshot 7:

Accessory Suggestions for /textured-backdrop-background-concept.jpg: 1. **Earrings**: Gold hoop earrings with lapis blue enamel detailing
2. **Necklaces**: Delicate layered gold chain necklace with a turquoise pendant
3. **Handbags**: Structured white leather tote with cobalt blue accents
4. **Shoes**: Light gray ankle boots with a subtle metallic sheen
5. **Bracelets**: Stacked bangles in mixed metals (gold, silver, and gunmetal)
6. **Belts**: Navy blue suede belt with a statement brass buckle
7. **Scarves**: Lightweight silk scarf in a vibrant coral with abstract geometric patterns

After Validation:

Accessory Suggestions for /close-up-shiny-fabric-details.jpg: 1. Earrings: Gold hoop earrings with a deep amethyst stone. (Valid)
2. Necklaces: Layered gold chain necklace with a lavender pendant. (Valid)
3. Handbags: Textured crossbody bag in dusty rose. (Valid)
4. Shoes: Ankle boots in rich burgundy suede. (Valid)
5. Bracelets: Stackable bangle set in rose gold and plum. (Valid)
6. Belts: Wide belt in a light taupe with gold accents. (Valid)
7. Scarves: Lightweight scarf featuring a geometric print with hints of teal and metallic. (Valid)

Accessory Suggestions for /close-up-yellow-textured-surface.jpg: 1. Earrings: Geometric gold-tone hoop earrings
2. Necklaces: Layered chain necklace with mixed metal finishes
3. Handbags: Croc-embossed bucket bag in a soft taupe
4. Shoes: Ankle boots in dark burgundy leather
5. Bracelets: Stackable cuff bracelets in brushed gold
6. Belts: Wide tan leather belt with a brass buckle
7. Scarves: Lightweight printed scarf featuring hints of olive and navy

Accessory Suggestions for /flat-lay-textile.jpg: 1. Earrings: Gold hoop earrings with ruby red enamel accents (Valid)
2. Necklaces: Layered chain necklace with a deep burgundy pendant (Valid)
3. Handbags: Structured black leather handbag with gold hardware (Valid)
4. Shoes: Pointed toe ankle boots in a muted taupe shade (Valid)
5. Bracelets: Stacked bangles in rose gold and garnet (Valid)
6. Belts: Wide black belt with a bold gold buckle (Valid)
7. Scarves: Lightweight silk scarf featuring an abstract pattern in shades of cream and deep maroon (Valid)

Accessory Suggestions for /smooth-elegant-blue-fabric-material-texture.jpg: 1. Earrings: Gold hoop earrings with turquoise enamel inlay - Valid
2. Necklaces: Layered silver necklaces with a lapis lazuli pendant - Valid
3. Handbags: Coral crossbody bag with gold hardware - Valid
4. Shoes: White chunky sneakers with blue accents - Valid
5. Bracelets: Beaded bracelet set with varying shades of aqua and navy - Valid
6. Belts: Tan wide belt with gold buckle - Valid
7. Scarves: Light grey scarf with abstract blue and green patterns - Valid

6. CONCLUSIONS

This study shows that AI and machine learning models holds the sensational likelihood in fashion area. The system can provide appropriate accessory suggestions which can help fashion designers, stylists, and enthusiasts in bringing together organized and stylish apparel by extracting the colors from images of the fabric. The results confirms the sustainability of integration of technology to increase the fashion selections with creativeness, ensuring both short and long term assistances.

Looking ahead, this invention can transform the overall experience of shopping and how customers can choose and bring together outfits with accessories also this approach can be in combined into online platforms for shopping or for personal styling apps, bringing personalized and flexible recommendations associated with seasonal changes, style trend and with their own tastes.

7. Key Contributions

These useful implementation of AI models, like color extraction, clustering algorithms and generative models to propose accessory recommendations. Formation of the structure that controls the coordination concepts of color and distinct fondness to show personalized and stylish outfits. The combination of the text-to image generation to demonstrate the whole outfits, increasing the realism and tangibility of the recommendations.

8. Challenges

The lack or unreachability of the certain images files resulted in the elimination of some processes for exact entries, because of that the overall uniformity of the dataset impacted. Mostly due to excessively complex prompts or temporary server issues some of the attempts for text-to0image generation encountered hurdles.

9. Suggestions for Future Work

Extend the dataset: To improve the capacity of the system for varied and precise recommendations the range of the dataset should be more extensive with textures, patterns, and color palettes.

Refine the models: additionally fine-tune the Hugging Face models to improve fashion-related challenges and improve the accessory suggestions significance.

Automated valuation: To assess the quality and applicability of accessory recommendations, an automated evaluation system should be established making sure that the suggestions remain both practical and also fashionable.

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