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LuxeVogue: Personalized AI Fashion Recommendation System

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Abstract: This project presents LuxeVogue, an AI-powered web application that provides personalized fashion recommendations based on users' physical features. Utilizing computer vision techniques, the system analyzes uploaded images to detect skin tone and estimate body shape through keypoint detection. The skin tone is mapped to seasonal color palettes, while body measurements are used to classify body shape into categories such as hourglass, pear, rectangle, or inverted triangle. Based on these attributes and the current season, the application suggests tailored clothing and accessory styles, enhancing the user's fashion experience. Built using Streamlit, OpenCV, and Detectron2, the system also integrates a chatbot via IBM Watson for interactive user support. This project demonstrates the potential of combining AI and fashion for intelligent style guidance.

IndexTerms: LuxeVogue, Fashion recommendation system, Skin tone detection, Body shape detection, Computer vision, OpenCV, Detectron2, Augmented Reality (AR)

I. INTRODUCTION

In today's world, fashion is not just about clothes — it's a form of self-expression. However, finding styles that truly suit an individual's body shape and skin tone can be a challenge. This project, LuxeVogue, aims to solve that problem by using artificial intelligence to give personalized fashion advice.

The user simply uploads a photo, and the system analyzes the image using computer vision. It detects the user's skin tone and identifies their body shape using advanced models. Based on this information and the current season, the system recommends suitable clothing, jewelry, and outfit styles. It also provides color palettes and outfit inspirations to help users make better fashion choices.

II. RELATED WORK

2.1 Fashion Recommendation Systems

Fashion recommendation systems aim to enhance user experience by suggesting apparel and accessories based on preferences and behavioral data.

- **Deep Learning Approaches:** Deep learning-based recommendation systems utilize sophisticated algorithms, such as ResNet50, to enhance the accuracy of their recommendations. These models excel in analyzing complex visual data, making them particularly effective in applications where images play a central role, such as in fashion or product recommendations. By employing deep neural networks, systems can better understand user preferences and content features through both image analysis and collaborative filtering techniques. Collaborative filtering works by leveraging patterns in user behavior and preferences, improving the system's ability to recommend relevant items based on historical data. However, these systems often come with high computational demands, requiring substantial processing power, especially when working with large datasets. Moreover, their effectiveness heavily depends on the availability of high-quality, well-labeled datasets for training, which can pose challenges in domains with limited data[8].

- **Content-Based Filtering:** Content-based filtering recommends items based on their similarity to user preferences. For example, in apparel recommendation systems, algorithms like TF-IDF (Term Frequency-Inverse

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Document Frequency) analyze product descriptions and match them with user interests. This approach enables personalized recommendations based on individual user profiles. While content-based filtering excels at personalizing suggestions, it can struggle to adapt to rapid shifts in consumer trends. Since it relies on static product descriptions and historical data, the recommendations may become outdated or less reflective of current market trends[9].

2.2 Skin Color Detection

Accurate skin color detection is crucial in applications like personalized fashion recommendations and accessory suggestions, where aligning with an individual's skin tone enhances the user experience.

- **RGB, HSV, and YCbCr Models:** These color models, which are widely used in skin tone detection, provide methods for translating pixel values into color representations. RGB (Red, Green, Blue) relies on the primary colors of light to define a color, while HSV (Hue, Saturation, Value) emphasizes human perception of color, making it more adaptable to variations in color intensity. The YCbCr model separates luminance and chrominance components, which is particularly useful for identifying skin tones in digital images[2]. While these models enhance the precision of skin tone detection by providing distinct color channels for analysis, they face challenges in dealing with extreme lighting conditions[3][4]. For instance, skin tones can appear significantly altered under different lighting, leading to potential inaccuracies in detection. These models can struggle to maintain consistency when the environment introduces high levels of brightness or shadow.

- **Advanced Detection Algorithms:** More sophisticated techniques, such as Bayesian frameworks and dynamic thresholding, have been developed to address the issue of illumination variability in skin color detection. Bayesian frameworks use probabilistic models to estimate the most likely skin color given certain conditions, which helps in compensating for changes in lighting and environmental factors. Dynamic thresholding, on the other hand, adjusts the criteria for skin detection based on real-time input, making it more adaptive to changes in lighting conditions. These algorithms improve the robustness of skin color detection and allow for real-time applications, where accurate skin tone identification is crucial. However, these advanced methods come with their own set of challenges, particularly in terms of computational intensity. They require significant processing power, which may hinder their deployment on devices with limited resources, such as smartphones or wearable technology. Furthermore, the high resource dependency of these algorithms can limit their scalability and efficiency in large-scale systems[4].

2.3 Fashion Trend Forecasting

Artificial Intelligence (AI)-powered systems have revolutionized the way fashion trends are predicted by analyzing vast amounts of data from diverse sources, such as social media, blogs, and consumer behavior patterns. These systems offer a deeper understanding of emerging trends, enabling designers, retailers, and brands to stay ahead of the curve and create products that align with evolving consumer preferences.

- **Neural Networks with Knowledge Graphs**: Advanced AI systems that incorporate neural networks and knowledge graphs have greatly enhanced the ability to forecast fashion trends. Knowledge graphs are powerful tools that represent relationships between various entities, such as products, designers, and influencers, in a structured format. By integrating both structured data (like sales figures and product attributes) and unstructured data (such as social media posts or blog articles), these systems can provide a more comprehensive and accurate analysis of fashion trends. The incorporation of triplet regularization, a technique that enforces consistency in the relationships within the knowledge graph, further improves the prediction accuracy by preventing overfitting and ensuring that the relationships between different fashion items are meaningful. However, this added complexity comes at a cost in terms of computational resources. The need for powerful computing infrastructure can increase the operational costs and energy consumption, making it a challenge for organizations with limited technical capacity[5].

- **Social Media Analytics:** Social media platforms provide vast user-generated data for trend analysis. Graph Neural Networks (GNNs) and Natural Language Processing (NLP) models analyze text, images, and other content to detect trends. GNNs uncover interactions between users, influencers, and brands, identifying viral trends. NLP analyzes sentiment and interest through hashtags and comments. These tools are effective but can suffer from demographic bias and overfitting, leading to potentially skewed predictions[1][6].

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2.4 Immersive Technologies

Virtual try-on systems aim to replicate the in-store clothing trial experience through digital platforms, enhancing the convenience and engagement of online shopping. According to Wasnik et al. (2020), the system employs a virtual mirror implemented using a webcam and image processing techniques to capture a user's image and overlay fashion items in real time. The system utilizes OpenCV's Haar Cascade Classifier to detect the user's body and accurately align virtual clothing onto the captured image. By removing the need for physical fitting rooms, the system allows users to visualize how garments would appear on them, thereby reducing shopping time and improving purchasing decisions.

This technology is particularly valuable in the e-commerce domain, where customers often face uncertainty about how clothing will fit or look. The virtual mirror concept forms a foundational approach for more advanced fashion systems that incorporate body shape detection, skin tone analysis, and personalized fashion recommendations.[10]

III. PROPOSED SYSTEM

The proposed system is a web-based AI fashion recommendation platform named LuxeVogue. It provides personalized fashion advice based on a user's skin tone and body shape, using advanced computer vision and machine learning techniques.

Upon launching the application, users are prompted to upload a full-body image. This image is read from a designated path and undergoes a series of preprocessing steps. These include white balancing and Contrast Limited Adaptive Histogram Equalization (CLAHE) to enhance the image's visual quality and improve the accuracy of subsequent processing stages.

3.1 Skin Tone Detection

The system applies a skin segmentation technique by converting the image to the YCrCb color space and using frequent RGB color within the segmented region is then calculated[2]. This detected skin tone is matched to a predefined set of natural skin tones using Euclidean distance, and further mapped to a corresponding seasonal color palette (Spring, Summer, Autumn, or Winter). Each season is associated with a curated color scheme that complements the identified skin tone, which is then presented to the user as a palette suggestion.

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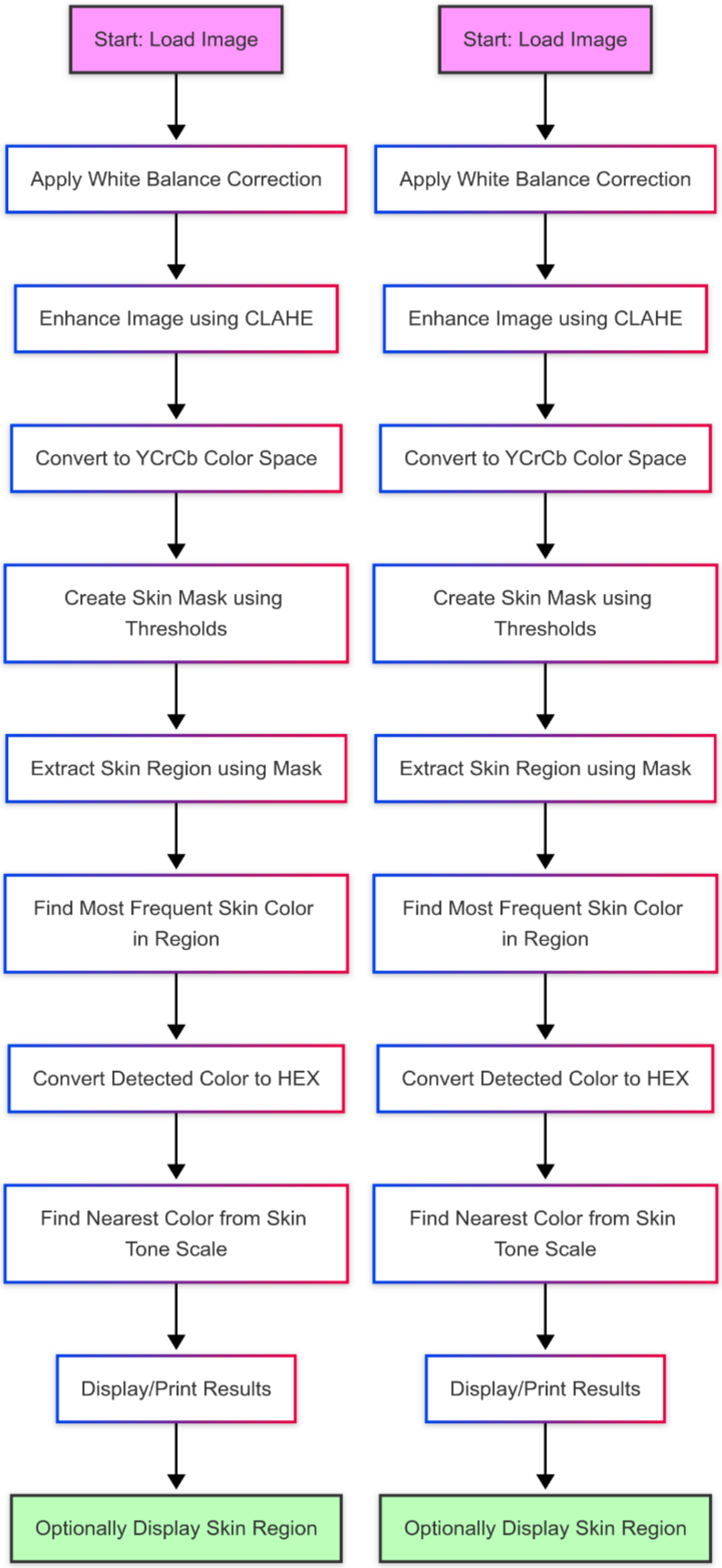

Fig-1: Flowchart of Skin Color Detection

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3.2 Body Shape Detection

For body shape analysis, the system uses Detectron2's Keypoint R-CNN model, pre-trained on the COCO dataset. This model detects 17 key human body landmarks, including shoulders, hips, elbows, and knees. Using these keypoints (Fig - 2 Body Keypoint Detection), the system calculates various body measurements such as bust width, waist width, shoulder width, and hip width through Euclidean distance formulas. These measurements are then used to classify the user's body shape into one of four categories: hourglass, pear, rectangle, or inverted triangle, based on a set of proportional heuristics[9].

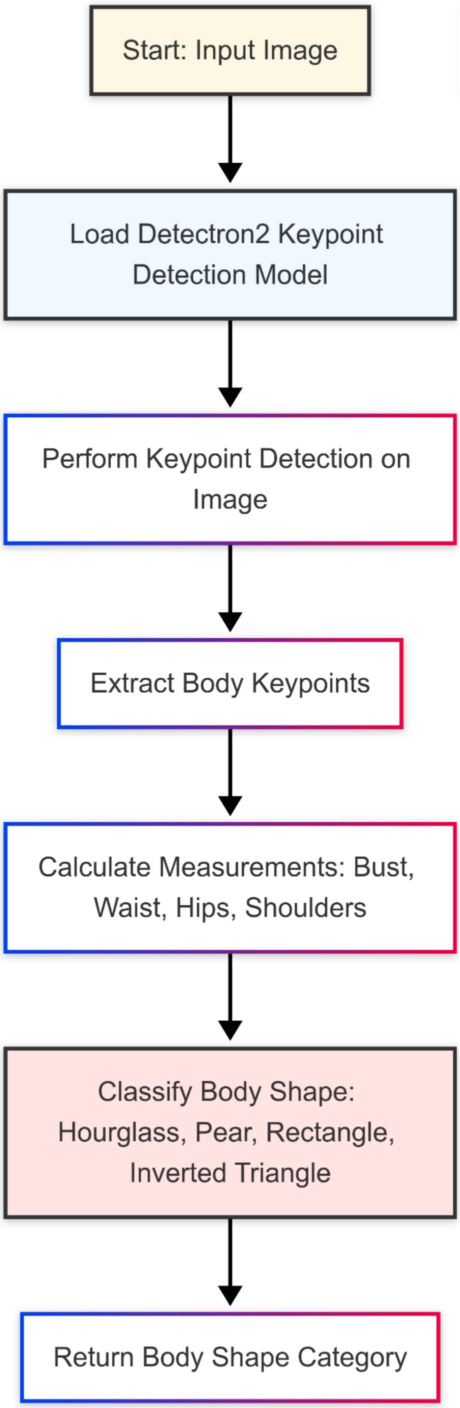

Fig-2: Workflow of Body Shape Recognision

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3.3 Fashion Recommendation Engine

With both the user’s skin tone season and body shape identified, the system references a predefined recommendation engine to generate fashion suggestions. Recommendations include clothing styles, jewelry types, casual outfits, and formal wear tailored to enhance and complement the user’s natural features and silhouette. These suggestions are seasonally aware, ensuring appropriate combinations based on environmental context and skin tone.

Considering that body image perception plays a significant role in how users relate to and adopt fashion choices, integrating psychological insights into the recommendation logic enhances both relevance and user satisfaction[7].

3.4 Outfit Visualization

To enhance user engagement and provide visual inspiration, the system uses the DuckDuckGo image search API to retrieve and display sample outfits that align with the user's detected body shape and skin tone palette. This step allows users to visually interpret the recommendations and potentially replicate similar styles in real life.

IV. RESULTS

Fig-3: Color Detection

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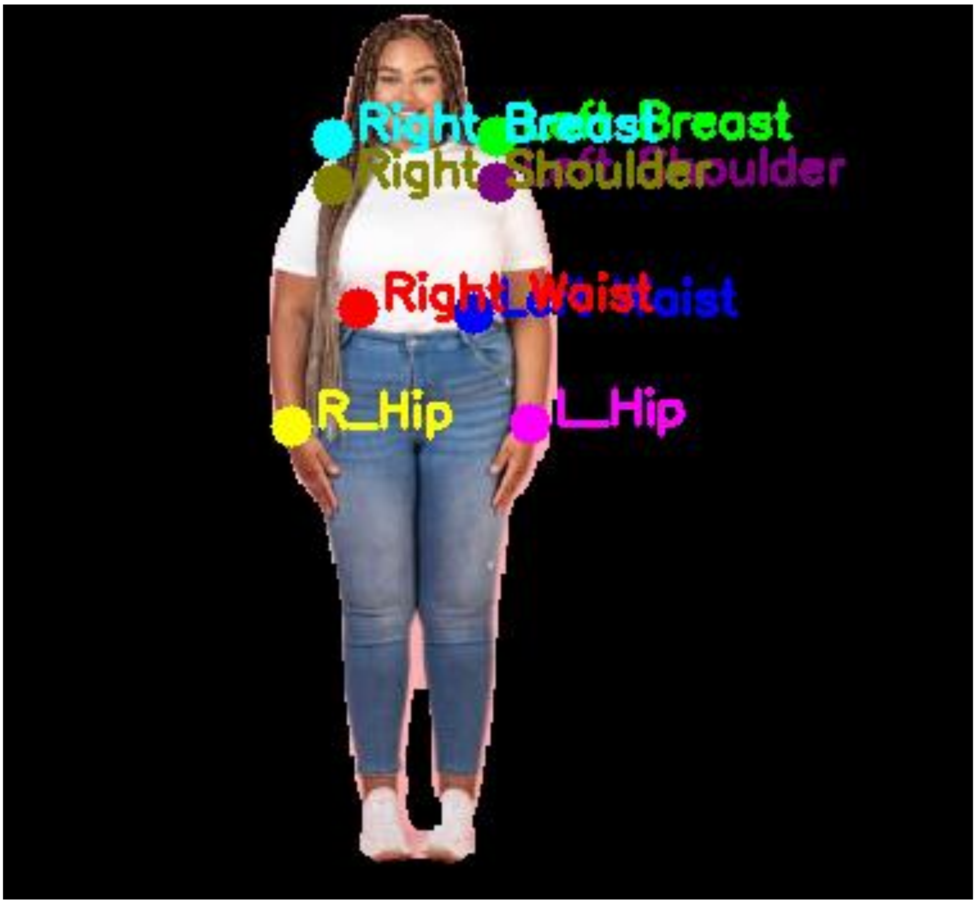

Fig-4: Body Keypoint Detection for Body Shape Identification

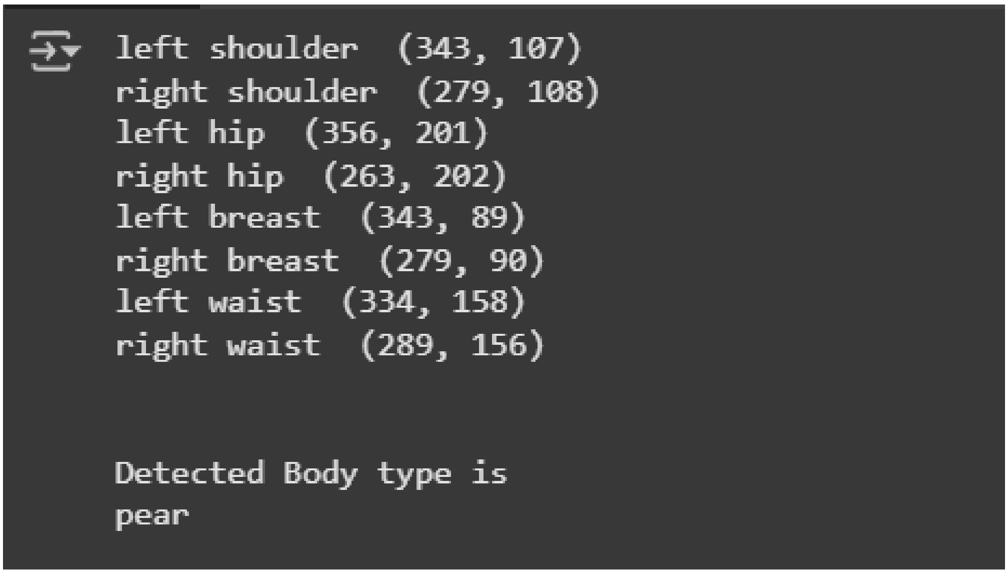

Fig-5: Coordinates of Keypoints

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Fig-6: Website Home Page

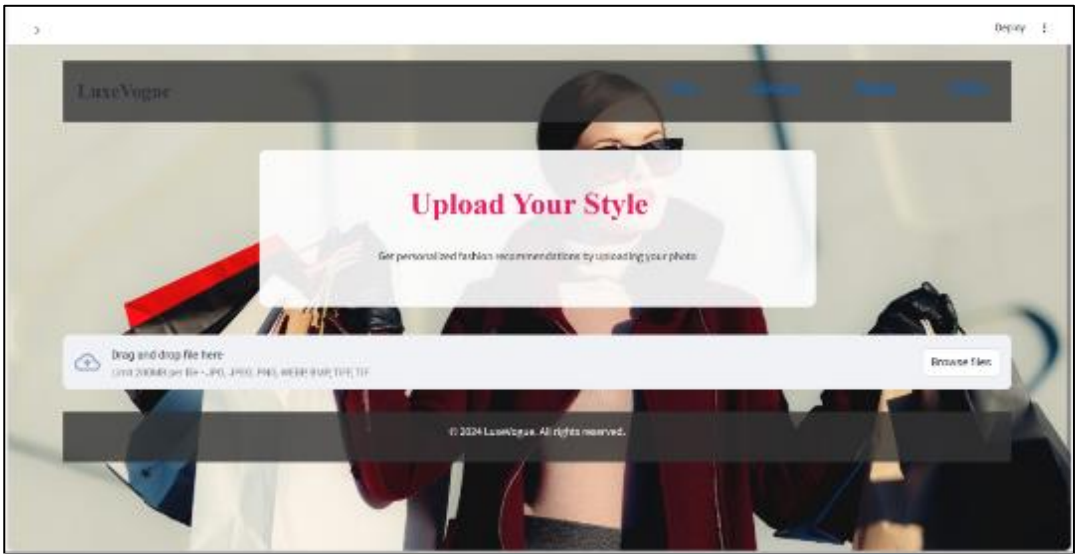

Fig-7: Website Page to Upload your image

Fig-8: Image File Uploaded

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Fig-9: Recommendation

Fig-10: Recommendation

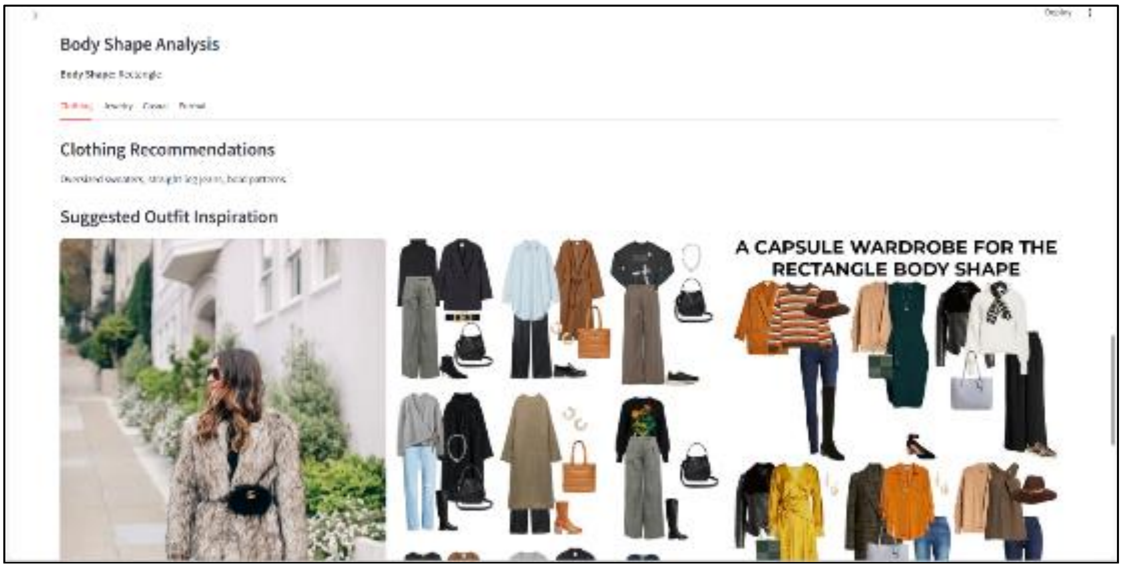

Fig-11: Recommendation

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V. CONCLUSIONS AND FUTURE SCOPE

5.1 Conclusion

In this project, we developed LuxeVogue, a smart fashion recommendation system that helps users choose clothing and accessories based on their skin tone and body shape. By using computer vision techniques, the system can analyze a photo uploaded by the user and give personalized fashion suggestions. The project uses tools like OpenCV for image processing, Detectron2 for body keypoint detection, and DuckDuckGo for showing outfit inspirations.

The system also includes a user-friendly interface created with Streamlit and provides chatbot support through IBM Watson Assistant. This makes the experience smooth, interactive, and helpful. Overall, LuxeVogue shows how artificial intelligence can be used in everyday life to make fashion more personal and easier to explore. It opens up new possibilities for using AI in the fashion and retail industry.

5.2 Future Scope

- **Integration with E-commerce Platforms:** The system can be connected to popular online fashion retailers such as Amazon, Myntra, or Zara. Once a user receives personalized fashion recommendations, the system can show matching products available on these platforms. This would allow users to directly browse, compare, and purchase outfits that are tailored to their body shape and skin tone.

- **Outfit Virtual Try-On (AR Integration):** With the help of Augmented Reality (AR), users could virtually try on clothes recommended by the system. This feature would use the camera to place selected outfits onto the user's body in real-time. It gives users a visual idea of how an outfit would look on them without physically trying it on.

- **Mobile Application Development:** Currently, the system runs as a web application. To reach a larger audience, it can be converted into a mobile application for Android and iOS platforms. A mobile app would make the service more convenient and accessible, allowing users to quickly upload selfies or access recommendations anytime and anywhere.

- **Cultural and Regional Style Customization:** Fashion preferences vary widely based on culture, tradition, and geography. In the future, the system could be enhanced to provide recommendations that align with a user's cultural background or regional trends. For example, it could suggest sarees or kurtis for Indian users, or kimonos for Japanese users, during traditional occasions.

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