Outfit Suggestion System Based On Body Shape

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Abstract—Fashion holds significant sway in our everyday lives, serving as a mirror of our personal style and identity. Yet, navigating the world of fashion and personal style presents challenges, particularly in choosing outfits that flatter individual body types and shapes. This process often proves daunting and time-consuming, leading to indecision and a lack of confidence in one's appearance. To tackle these hurdles, this study aims to develop an ML-based Outfit Suggestion System. Introducing an innovative approach, this system harnesses machine learning methodologies, including deep learning, computer vision, and natural language processing. By scrutinizing an extensive dataset encompassing clothing items and body shape attributes, the system furnishes tailored outfit recommendations designed to suit individual body types and shapes. This research marks a notable stride in the evolution of fashion recommendation systems, offering a promising avenue for fashion enthusiasts seeking personalized outfit guidance across varied contexts.

Keywords—Fashion Recommendation, Clothing Recommendation, Machine Learning, Fashion Dataset, Body Shape Analysis, Body Type Analysis, Body Types, Fashion.

I. INTRODUCTION

Fashion serves as a means for individuals to express their identity and social status, a tradition ingrained in human culture. With every person being unique in size, shape, and colour, the choice of attire becomes pivotal, influencing one's impression and presentation. As the world witnesses a surge in the integration of computer vision in the fashion industry, particularly in clothing recommendations, a notable gap remains in understanding the correlation between body shape and fashion choices. This gap persists due to the scarcity of datasets encompassing both clothing category and comprehensive body shape annotations.

The COVID-19 pandemic has accelerated the shift from traditional in-store fashion shopping to online platforms, necessitating an enhancement of the online shopping experience. Artificial Intelligence and Machine Learning (AIML) technologies present viable solutions to address industry-specific challenges, including those within the fashion sector. Many consumers grapple with uncertainty when purchasing clothes online, lacking clarity on suitability and style preferences. Consequently, there is a growing demand for customizable recommendation systems tailored to individual needs and preferences, enhancing both user satisfaction and e-commerce efficiency.

In response to this demand, our research endeavors to develop an improved recommendation system leveraging pre-trained models to cater to varying body types. The objectives of our study include accurately measuring body silhouette, predicting suitable apparel based on body type through image classification, and evaluating the efficacy of pre-trained and traditional models. The organization of our paper entails a comprehensive review of related work, followed by the presentation of our proposed methodology, discussion of results, and concluding remarks.

Our project is dedicated to achieving several key objectives. Firstly, we aim to enhance user confidence by providing personalized outfit suggestions that prioritize comfort and style, recognizing the profound impact of fashion on self-esteem and confidence. Secondly, we endeavor to streamline decision-making for users confronted with an overwhelming array of fashion choices by offering tailored recommendations based on individual preferences and body type. Additionally, we seek to foster personal style as a unique form of self-expression, encouraging users to explore and refine their fashion identity. Lastly, in response to the dynamic nature of the fashion landscape, our project is committed to meeting evolving consumer needs by delivering up-to-date recommendations that align with the latest trends and cultural influences.

II. LITERATURE SURVEY

The literature on fashion recommendation systems encompasses various approaches leveraging machine learning and deep learning techniques. Research by Hou et al. [2] focuses on explainable fashion recommendation using semantic attribute region guidance. Hidayati et al. [3] explore clothing style recommendations tailored to personal body shapes. Wang et al. [4] propose collaborative deep learning for recommender systems. Other studies, such as Koshy et al. [5] and Hao et al. [6], delve into complexion-based outfit color recommendation and intelligent clothing selection systems, respectively.

Further contributions include research by Ayush et al. [7] on powering virtual try-on through auxiliary human segmentation learning and Ramesh et al. [8] on outfit recommender systems. Additionally, Zeng et al. [9] discuss real-time virtual try-on using image warping techniques, while Limaksornkul et al. [10] present a statistical-based apparel recommendation system named Smart Closet.

In terms of image analysis, Dwina et al. [11] discuss skin segmentation methods, and Duan et al. [12] address image classification using the VGG network. Seo and Shin [13] examine fine-grained fashion image classification based on style, while Wang et al. [14] propose an attentive fashion grammar network for fashion landmark detection and clothing category classification.

Recent studies also include work by Quintino Ferreira et al. [15] on pose-guided attention for multi-label fashion image classification and Meshkini et al. [16] on analyzing convolutional neural networks for fashion image classification. Key contributions to deep learning include research by Szegedy et al. [17] on deeper convolutions, He et al. [18] on residual learning, and Simonyan and Zisserman [19] on very deep convolutional networks.

Additionally, Wazarkar and Keshavamurthy [20] propose fashion image classification using matching points with linear convolution.

III. METHODOLOGY

Our research embarked on a meticulous and comprehensive methodology aimed at developing and implementing an ML-based outfit suggestion system tailored to individual preferences. The initial stage involved dataset creation, a process of extensive research and data collection from various sources, including online fashion platforms, blogs, social media outlets, and fashion magazines. This exhaustive dataset compilation involved gathering a diverse range of images depicting different clothing items, accessories, and fashion ensembles, thereby laying the groundwork for subsequent analysis and model training.

Following the dataset creation phase, we meticulously curated a training dataset to facilitate the effective training of our machine learning algorithms. This involved the selection of a representative subset of the raw data and the careful annotation of images with detailed labels, categorizing clothing types, styles, colors, patterns, and other relevant attributes. Concurrently, we set aside a portion of the curated dataset as test data to rigorously evaluate the generalization capacity and performance of our model.

Feature engineering emerged as a critical component of our methodology, where we undertook the extraction of salient features from the image data. This feature extraction process involved sophisticated techniques to capture and represent key visual characteristics such as color distributions, texture patterns, shape descriptors, and spatial relationships within the clothing items. These extracted features formed the foundation for subsequent model training and recommendation generation.

Preceding the model training phase, a meticulous data transformation and preprocessing step were undertaken to ensure the suitability and effectiveness of the input data for the machine learning algorithms. This involved standardizing, normalizing, and encoding the extracted features to mitigate potential biases, enhance model convergence, and optimize predictive performance.

Our approach also encompassed a multimodal evaluation framework, wherein we integrated additional modalities such as textual descriptions, user preferences, and contextual information to enrich the recommendation system's capabilities. This holistic evaluation methodology allowed us to assess the synergistic impact of diverse data sources on the system's accuracy, robustness, and user satisfaction.

Subsequently, we delved into the model training process, leveraging the powerful Decision Tree Classifier algorithm to unravel the intricate relationships between different clothing items and user preferences. This algorithmic choice was motivated by its interpretability, scalability, and ability to handle both numerical and categorical data, making it well-suited for our task of outfit recommendation generation.

Armed with a trained machine learning model, our system was adept at generating personalized outfit recommendations tailored to individual users' preferences, style preferences, and body types. These recommendations were dynamically generated based on input images, textual descriptions, and user feedback, thereby offering users a seamless and intuitive shopping experience.

To facilitate real-world deployment, we seamlessly integrated our trained model with the Flask framework, a lightweight and flexible web application framework for Python. This integration enabled us to develop a user-friendly web interface, allowing users to access personalized outfit recommendations in real-time and interact with the system effortlessly.

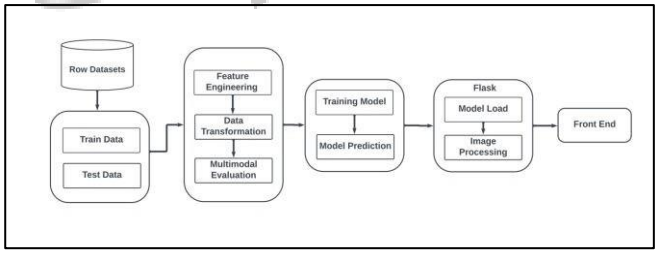

Figure 1 System Architecture

Furthermore, we ensured efficient model loading and inference upon initializing the Flask application, thereby minimizing latency and enhancing user experience. As users interacted with the system through the frontend interface, input images were processed using the loaded machine learning model, and recommended outfits were dynamically

displayed, empowering users to explore and select their preferred options seamlessly and confidently.

IV. ADVANTAGES

1. Personalized Fashion Recommendations: The system leverages machine learning to provide highly personalized outfit suggestions based on individual body types, addressing the unique preferences and styles of users.
2. Time-Efficient Wardrobe Curation: By automating outfit suggestions, the system streamlines the process of curating a stylish wardrobe, saving users valuable time that would otherwise be spent on decision-making and selection.
3. Enhanced Confidence and Self-Image: Tailored outfit recommendations contribute to improved user confidence by suggesting clothing that complements their body shape and personal style, fostering a positive self-image.
4. Incorporation of Deep Learning and Computer Vision: State-of-the-art techniques ensure a sophisticated analysis of clothing items, enabling the system to consider not only user preferences but also visual aspects like color, style, and fabric.
5. Versatility Across Fashion Contexts: The system's adaptability allows it to provide outfit suggestions for various contexts, including work attire, casual wear, or special occasions, offering users versatility in their fashion choices.
6. Comprehensive Dataset Utilization: Leveraging a comprehensive dataset of clothing items enhances the system's accuracy and relevance, ensuring a wide range of fashion options and staying updated with the latest trends.
7. Improved Decision-Making: By reducing decision paralysis, the system empowers users to make confident and informed decisions when selecting outfits, contributing to a more enjoyable and stress-free fashion experience.
8. Integration of Natural Language Processing: The incorporation of natural language processing techniques facilitates a user-friendly interaction, allowing users to communicate preferences and receive recommendations in a seamless and intuitive manner.
9. Sustainable and Ethical Fashion Considerations: The system can incorporate information about the sustainability and ethical standards of clothing brands, promoting responsible fashion choices among users.

V. ALGORITHM

1. Dataset Preparation:
The algorithm starts with the preparation of the dataset, which consists of labeled images of outfits along with corresponding metadata such as clothing types, styles, and body measurements.
Data preprocessing techniques are applied to clean the dataset, remove noise, and ensure uniformity.

2. Feature Engineering:
Feature engineering involves extracting relevant features from the dataset that will be used as input for the ML models.
Features may include body measurements (e.g., shoulder width, waist circumference), clothing attributes (e.g., color, pattern), and contextual information (e.g., weather, occasion).

3. Data Transformation:
The algorithm performs data transformation to prepare the features for model training.
Techniques such as normalization, scaling, and encoding are applied to standardize the data and make it suitable for input to the ML algorithms.

4. Multi-Model Evaluation:
Multiple ML algorithms, including decision trees, random forests, and regression models, are evaluated for their performance in predicting suitable outfits.
Evaluation metrics such as accuracy, precision, recall, and F1-score are calculated to assess the effectiveness of each model.

5. Model Training:
The algorithm trains the selected ML models using the preprocessed and transformed dataset.
Hyperparameter tuning and cross-validation techniques are applied to optimize model performance and prevent overfitting.

6. Model Prediction:
Once trained, the ML models are used to predict suitable outfits based on user inputs.
Ensemble methods may be employed to combine predictions from multiple models for improved accuracy and robustness.

7. Integration with Flask Framework:
The Flask framework is integrated into the algorithm to facilitate communication between the ML models and the web application.
Flask is used for model loading, file integration, and handling user requests for outfit recommendations.

8. Backend Integration:
User inputs from the presentation layer are redirected to the backend, where the ML models generate outfit recommendations.
The backend communicates with the ML models to process user inputs, generate predictions, and return outfit suggestions to the frontend.

9. Frontend Presentation:
The results generated by the backend are presented to users through the frontend interface of the web application.
Users can view personalized outfit recommendations based on their body type, preferences, and contextual information.

VI. FUTURE SCOPE

User Feedback Integration: Incorporate mechanisms for gathering and analyzing user feedback regarding recommended outfits to continuously refine the recommendation algorithms. This iterative process aims to enhance the system's accuracy and relevance over time based on user input.

Dataset Expansion: Continuously update and expand the dataset with new clothing items, style trends, and body shape attributes. This ensures that the system remains current and capable of providing relevant recommendations in line with evolving fashion trends and user preferences.

Mobile Application Development: Develop a user-friendly mobile application to facilitate convenient access to the outfit suggestion system on mobile devices. This initiative aims to enhance accessibility, allowing users to receive personalized recommendations wherever they are.

Using Augmented Reality: Explore the integration of augmented reality technology to enable users to virtually try on recommended outfits in real-time. This immersive experience empowers users to visualize potential purchases before committing, bolstering their confidence in their fashion decisions.

Intelligent Wardrobe Management: Create features that enable users to digitally organize their existing wardrobe items and receive recommendations for outfit combinations utilizing their current clothing pieces. This functionality helps users maximize the versatility of their wardrobe and minimize unnecessary purchases.

VII. RESULTS

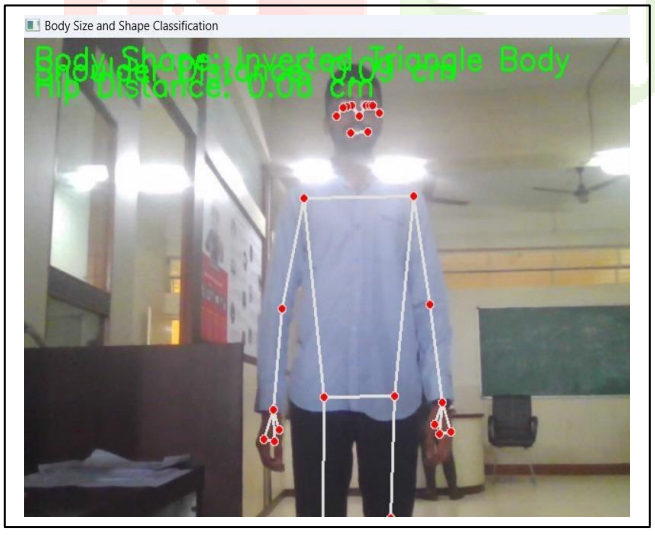

Figure 2. The image showcases a person standing before a camera, to take input with OpenCV technology employed to capture precise measurements of their body shape. The subject stands in a neutral pose, allowing for accurate assessment of body proportions.

Figure 3. The image features a selection of recommended outfits curated for the specific body shape of the user. showcasing the system's ability to provide personalized fashion guidance.

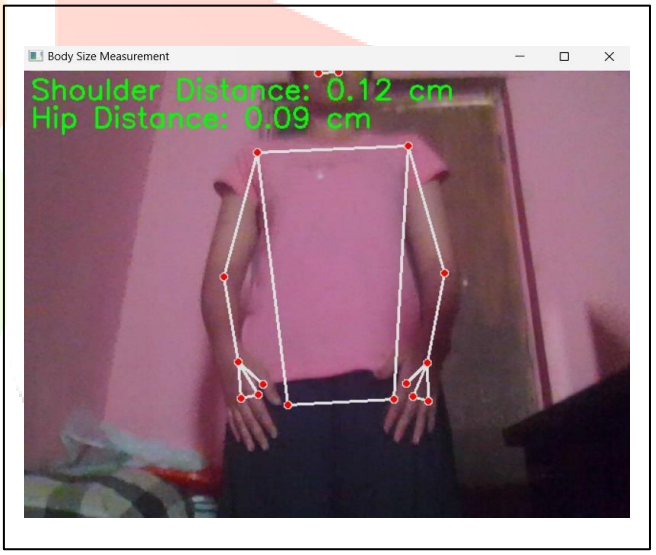

Figure 4. The image depicts a woman standing before a camera, with OpenCV technology capturing measurements of her body shape.

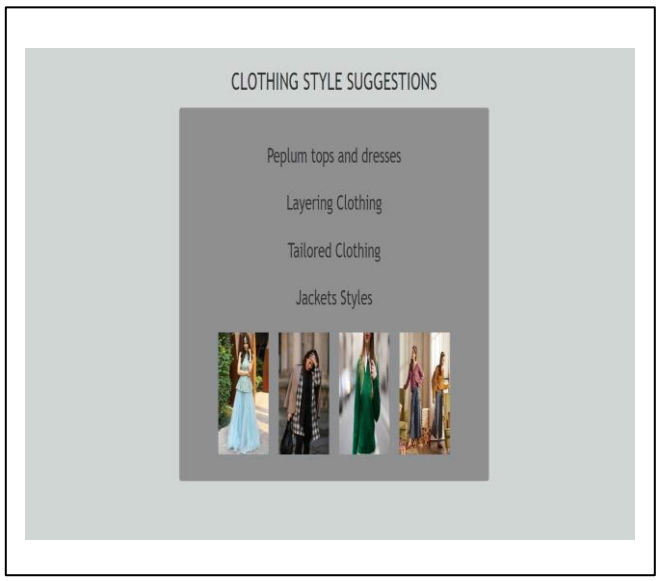

Figure 5. The image features a selection of recommended outfits curated for female body shape. showcasing the system's ability to provide personalized fashion guidance

VIII. CONCLUSION

In conclusion, the creation of the ML-Based Outfit Suggestion System marks a significant advancement in revolutionizing the fashion industry and addressing the challenges individuals encounter in curating a fashionable wardrobe. This project harnesses state-of-the-art technologies like deep learning, computer vision, and natural language processing to introduce a novel and personalized solution.

The system's advantages are apparent in its capacity to deliver highly customized fashion recommendations, simplify wardrobe management, and boost user confidence by considering individual body shapes and style preferences. By integrating advanced technologies such as augmented reality for virtual try-ons and machine learning for trend analysis, the system emerges as a leader in fashion recommendation innovation.

Moreover, the system's adaptability enables a wide range of applications, spanning from e-commerce platforms and fashion retailers to social media integration and sustainable fashion initiatives. Its potential impact extends across various industries, fostering improved user experiences, informed fashion decisions, and advancements in fashion recommendation systems overall.

Nevertheless, challenges such as ensuring data accuracy, addressing privacy concerns, and navigating ethical considerations must be carefully managed during the system's implementation. Maintaining a delicate balance between personalization and privacy is paramount to preserving user trust and satisfaction.

In summary, the ML-Based Outfit Suggestion System not only provides a pragmatic solution for fashion enthusiasts seeking personalized outfit recommendations but also drives the broader evolution of fashion recommendation systems. Its utilization of advanced technologies and emphasis on individual preferences positions it as a promising tool in reshaping the fashion landscape. As technology continues to progress, the system holds the potential to establish new benchmarks for personalized and intelligent fashion experiences.

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