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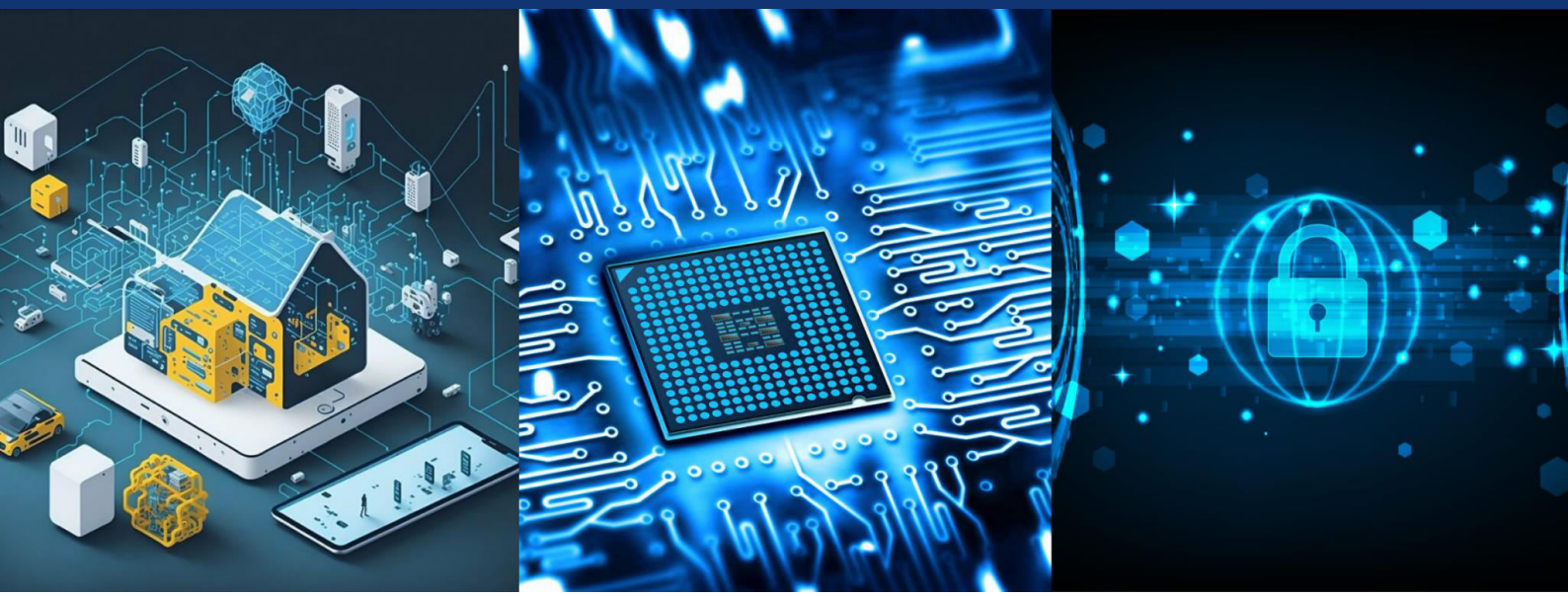

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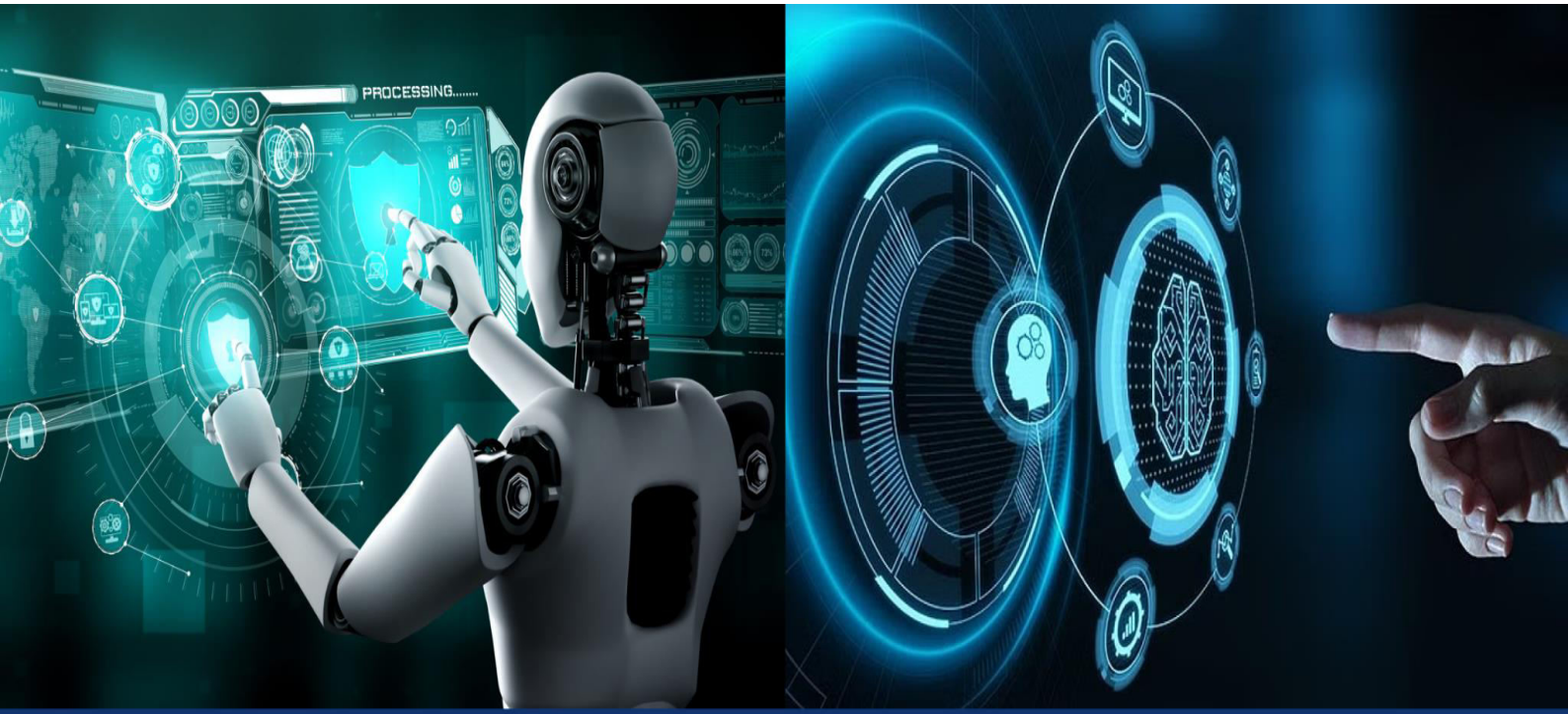

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AI-Powered Personal Style Recommender Using Image Analysis

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ABSTRACT: The AI-Powered Personal Style Recommender Using Image Analysis and Deep Learning improves the fashion selection experience. It uses artificial intelligence to understand clothing through images and provide tailored outfit recommendations. Unlike traditional systems that depend on purchase history or text descriptions, this system analyzes garment images with deep learning models to identify important visual features like color combinations, texture, and style patterns. Users can upload clothing images, receive coordinated outfit suggestions, and see styling combinations. By integrating deep learning for feature extraction, similarity matching, and user preference modeling, the platform provides precise and personalized recommendations. It has secure data handling methods and scalable cloud storage to ensure reliability and performance. This recommender focuses on the user, enhancing personalization, visual compatibility, and decision-making in digital fashion platforms.

KEYWORDS: AI-Powered Personal Style Recommender, Deep Learning, Image Analysis, Convolutional Neural Networks (CNN),Feature Extraction,Similarity Matching,Generative Adversarial Networks (GAN),Virtual Styling,Fashion Recommendation,Personalized Fashion,Virtual Try-on,Computer Vision

I. INTRODUCTION

The rapid growth of online fashion platforms has transformed the way people shop for clothing. However, selecting outfits that match personal style preferences remains a challenging task due to the vast number of available options. Traditional recommendation systems rely heavily on user ratings, browsing history, or metadata, which often fail to capture the visual compatibility between garments.

Fashion is primarily a visual domain where colour harmony, fabric texture, pattern alignment, and overall aesthetic balance play a crucial role. The AI-Powered Personal Style Recommender aims to address these challenges by introducing an intelligent system capable of analysing clothing images using deep learning techniques. By extracting visual features directly from images, the system generates outfit recommendations that are visually consistent and personalized according to user preferences.

Through automation and artificial intelligence, the proposed system enhances user experience, reduces decision fatigue, and supports smarter fashion choices.

1.1 Problem Statement

In online fashion platforms, users often struggle to find outfits that match their personal style due to the absence of visually intelligent recommendation mechanisms. Existing systems primarily depend on collaborative filtering or keyword-based matching, which do not effectively analyse clothing appearance.Users face difficulty in identifying garments that complement each other visually. Additionally, new users with limited interaction history receive less accurate recommendations. There is a need for a deep learning-based system that can analyse clothing images, understand visual compatibility, and provide personalized outfit suggestions in real-time.

1.2 Objective of the Study The primary objective of this study is to design and develop an AI-Powered Personal Style Recommender that generates
personalized outfit recommendations using image analysis and deep learning techniques.

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The specific objectives include developing a user-friendly platform that allows users to upload clothing images and receive styling suggestions. The system aims to extract meaningful visual features from garment images using convolutional neural networks. It focuses on matching clothing items based on similarity and compatibility metrics to create coordinated outfits. Additionally, the system integrates secure cloud-based storage for managing image data and recommendation history. The overall goal is to enhance personalization, improve visual compatibility, and deliver an intelligent digital styling experience.

II. LITERATURE REVIEW

Recent advancements in artificial intelligence and computer vision have significantly influenced recommendation systems. Researchers have explored various deep learning techniques for visual feature extraction and similarity learning. In paper [1], modern systems use Convolutional Neural Networks (CNNs), such as ResNet-50, to analyze clothing images. These models allow the system to "see" and understand visual elements like color, texture, and pattern that traditional keyword- based systems miss. In paper [2], research has moved beyond identifying identical items to understanding what "matches". By using similarity engines and cosine ranking, systems can evaluate how well different garments complement each other based on aesthetic balance and style attributes. In paper [3], combining user history (collaborative filtering) with visual analysis (deep learning) has been shown to improve personalization accuracy. This approach helps solve the "cold start" problem for new users by providing recommendations based on the visual features of their first upload. In paper [4], recent studies have integrated Generative Adversarial Networks to move from static images to interactive previews. These systems use pose estimation and semantic segmentation to overlay clothing onto a user's body, significantly increasing user confidence in online shopping. Furthermore, these approaches demonstrate how deep learning techniques can effectively understand complex fashion attributes and generate more accurate recommendations. The combination of visual analysis and intelligent recommendation strategies has made AI-driven fashion systems more efficient and user-centric.

III. PROPOSED SYSTEM

The proposed AI-Powered Personal Style Recommender utilizes advanced computer vision and machine learning to provide personalized fashion advice, bridging the gap between digital retail and individual physical attributes. Unlike traditional recommendation systems that rely solely on browsing history, this system analyzes a user's unique physical characteristics— such as body shape, skin tone, and existing wardrobe—to provide scientifically backed styling suggestions. This approach reduces the high return rates in e-commerce and empowers users with confidence in their daily styling choices.

The system processes clothing images using deep learning models to extract visual features such as color, texture, and pattern. These features are then compared using similarity matching techniques to identify clothing items that complement each other. By combining visual analysis with user preferences, the system can generate coordinated outfit recommendations that match different occasions and personal style preferences.

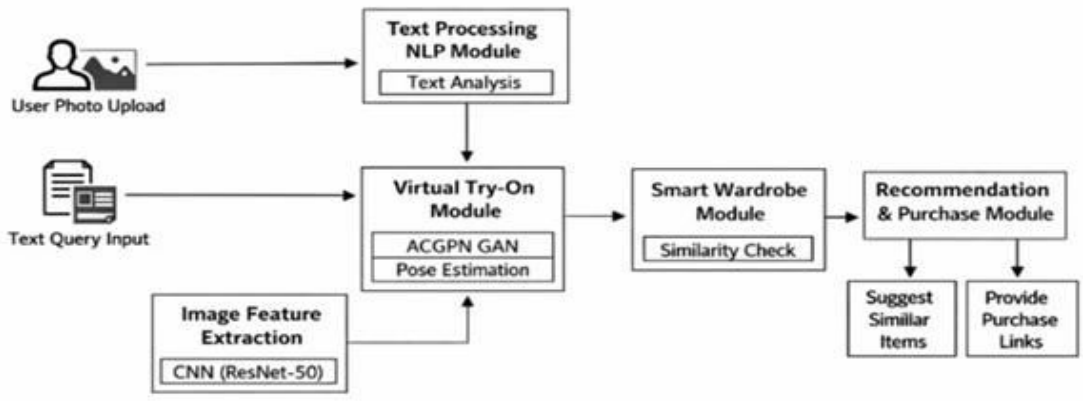

Fig.1.Architecture of the system

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A s shown in Fig. 1, the system begins with the user providing an image through a webcam or file upload. The Image Preprocessing Module handles noise reduction and normalization. The system then branches into two primary analytical tracks: the Body Shape Analysis Module, which identifies morphological proportions, and the Skin Tone & Color Analysis Module, which determines the user's seasonal color palette.

The extracted features are processed by the Recommendation Engine, which cross-references personal data with a comprehensive Fashion Attribute Database. The engine selects garments that harmonize with the user's features. Finally, the Virtual Try-On (VTO) Module allows users to visualize these recommendations on their own digital likeness before the Display Module presents the final curated style guide. To provide a clearer understanding of the internal workflow, the architecture is divided into the following functional modules.

3.1 Image Acquisition & Preprocessing Module The system captures or receives images of the user and their clothing items. This module performs essential operations like resizing, background removal (using rembg or GrabCut), and lighting normalization. This ensures that environmental factors do not interfere with color accuracy or body landmark detection. 3.2 Body Shape Detection Module This module utilizes MediaPipe Pose or OpenPose to identify key skeletal landmarks (shoulders, waist, and hips). By calculating the Euclidean distances between these landmarks, the system classifies the user's body shape (e.g., Hourglass, Rectangle, Pear).

3.3 Color Palette Analysis Module
The Color Palette Module extracts skin, hair, and eye colors using K-Means Clustering on specific regions of interest (ROI). It maps these values to Seasonal Color Theory (Spring, Summer, Autumn, Winter). This allows the system to suggest clothing colors that provide the most aesthetic contrast or harmony with the user's natural complexion.

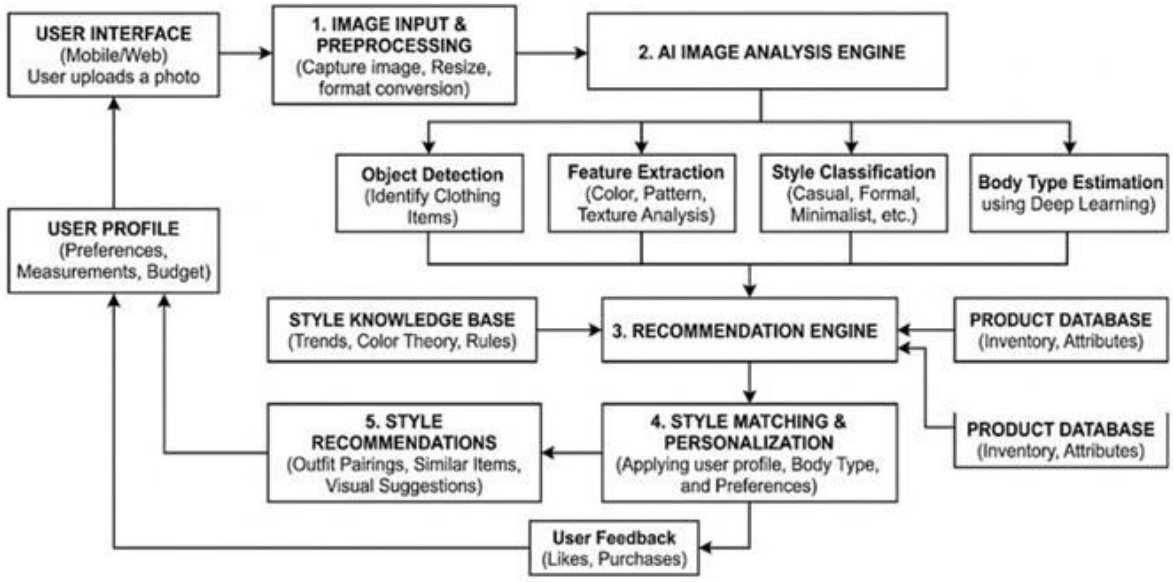

Fig. 2. Functional block diagram

3.4 Wardrobe Classification Module Using Convolutional Neural Networks (CNNs) like ResNet or EfficientNet, this module categorizes user-uploaded clothing images. It extracts features such as garment type (e.g., "blazer," "slim-fit jeans"), texture, and pattern. This allows the system to recommend "missing pieces" that would complement the user's current inventory.

3.5 Style Recommendation Engine
The Recommendation Engine acts as the central logic unit. It applies a Rule-Based Filtering mechanism derived from professional styling principles (e.g., "If body type = V-Shape, recommend wide-leg trousers to balance proportions"). It combines these rules with a Collaborative Filtering approach to suggest trendy items that align with the user's identified "Style Persona."

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3.6 Virtual Try-On (VTO) Module The VTO Module uses Generative Adversarial Networks (GANs) to perform "Virtual Cloth Warping." It overlays the recommended garment onto the user's body landmarks, adjusting for orientation and fit. This provides a realistic visual confirmation, helping the user understand how a recommended cut will look on their specific frame.

3.7 Feedback & Personalization Module

After a recommendation is provided, the system tracks user interactions (e.g., "Liked," "Purchased," or "Dismissed"). This feedback loop allows the system to refine its internal weights, ensuring that future recommendations become increasingly aligned with the user's evolving personal taste.

3.8 Environment Calibration Module

The Calibration Module adjusts for variations in camera quality and ambient lighting. By analyzing a known reference point (like a white balance card or facial skin tones), it fine-tunes the HSV (Hue, Saturation, Value) ranges to ensure the most accurate color extraction possible across different environments.

IV. METHODOLOGY

4.1 AI-Powered Style Recommendation & Synthesis Algorithm

The proposed AI-Powered Personal Style Recommender utilizes a combination of geometric body analysis and Generative Adversarial Networks (GANs) for realistic style synthesis. The overall working concept of the system is illustrated in Fig.3

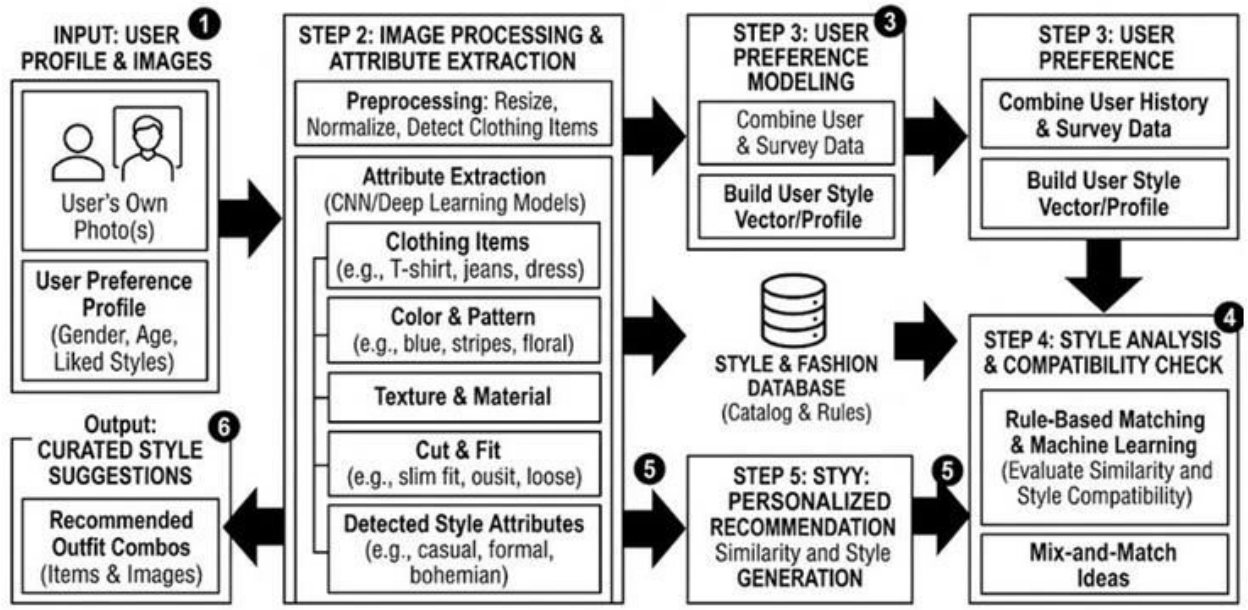

Fig. 3. Algorithm Working Concept

As shown in Fig. 3, the system captures a user's image and processes it through a dual-stream pipeline. One stream focuses on Feature Extraction (body landmarks and skin tone), while the second stream utilizes a Generative Module to visualize clothing items on the user's digital twin. This allows the system to not only recommend styles but also demonstrate them through virtual try-on technology.

Each input frame undergoes preprocessing using OpenCV, including background subtraction and brightness normalization to ensure consistent color extraction. The system utilizes a Pose Estimation Model to detect 33 skeletal landmarks, providing the spatial data necessary to determine body proportions.

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The recommendation logic follows a hybrid approach:
1.Geometric Filtering: Calculating ratios between shoulder, waist, and hip landmarks to categorize body shapes.
2.Colorimetric Mapping: Using K-Means clustering to identify skin undertones and matching them against seasonal color palettes.
3.GAN-Based Synthesis: Utilizing a Virtual Try-On Network (VITON) architecture. A Generator network takes the user's pose map and a target clothing image to create a synthesized "try-on" image, while a Discriminator ensures the result looks realistic and aligns with the user's body contours.
Once a style is synthesized, it is evaluated by the recommendation engine. The final output is translated into a curated "Style Card" through the command mapping module. The complete structured processing pipeline is depicted in Fig.4.

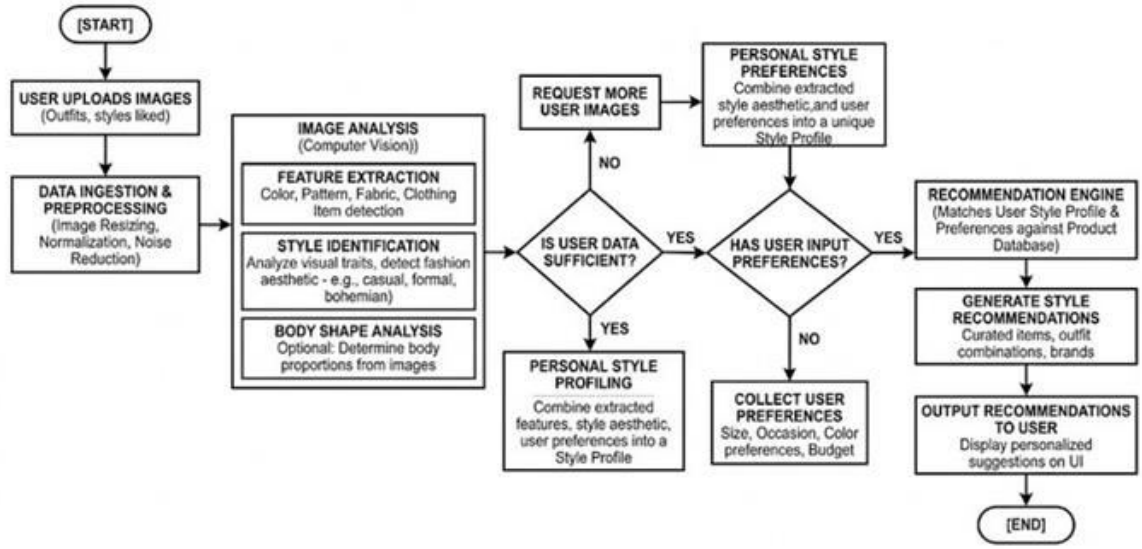

Fig. 4. Algorithm flowchart

As shown in Fig. 4, the overall algorithm follows a structured processing pipeline: Image Acquisition → Preprocessing
→ Landmark & Color Extraction → Feature Mapping → GAN-Based Virtual Try-On → Style Filtering → Recommendation Output → User Feedback Loop.
This modular flow ensures that the AI learns from user preferences over time. The integration of Deep Learning and GANs ensures high-fidelity visualizations and mathematically accurate styling, making it a robust solution for personalized digital fashion.

V. RESULTS AND DISCUSSION

The proposed AI-Powered Personal Style Recommender Using Image Analysis was successfully implemented as a web- based application that provides personalized fashion recommendations based on user images and contextual inputs. The system analyzes uploaded full-body photographs along with user preferences such as gender, occasion, and skin tone to generate suitable outfit suggestions. Experimental results show that the system effectively identifies visual features and produces relevant styling recommendations that align with the user's characteristics. Additionally, the integration of modules such as the digital wardrobe, AI stylist analysis, and 2D virtual try-on enhances the overall user experience by allowing users to manage clothing items and visualize outfit combinations before selection. The results demonstrate that combining image analysis with personalized user inputs improves the accuracy and practicality of fashion recommendations, making the system a useful tool for assisting users in making better styling decisions.

5.1 User Authentication Interface The user authentication interface serves as the entry point to the VogueAI platform. As illustrated in **Figure 5**, the login page provides a simple and intuitive interface that allows users to access their personalized fashion stylist services.

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The interface includes input fields for the user's name and phone number, enabling lightweight authentication while maintaining ease of use. The design follows a modern dark-themed user interface with minimalistic components, improving readability and reducing visual clutter. A clear call-to-action button labeled “Login Now” allows users to proceed to the system dashboard after authentication. Additionally, the page includes a registration option for new users who do not yet have an account. This streamlined authentication process ensures a smooth onboarding experience and facilitates quick access to the system’s AI-powered styling features.

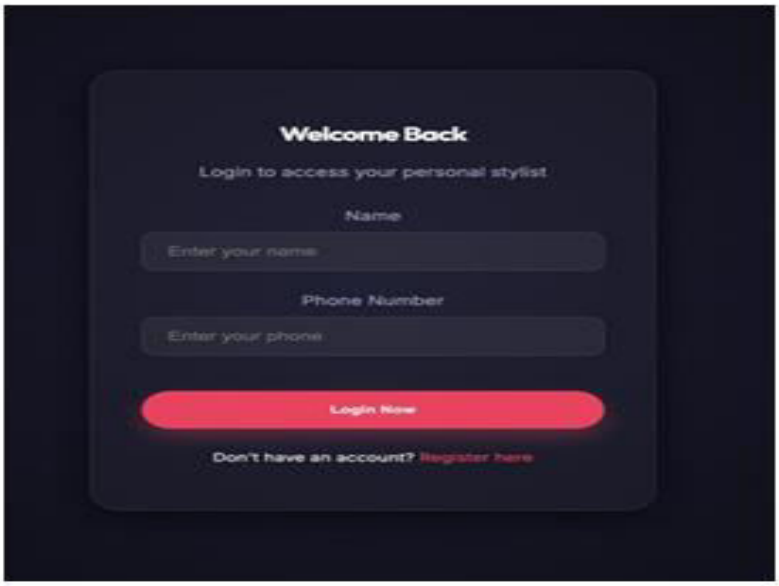

Fig. 5. User Authentication Interface

5.2 User Dashboard The dashboard serves as the central workspace for users after login, providing quick access to the main features of the VogueAI platform. It includes three key modules: Digital Wardrobe, AI Magic Stylist, and 2D AI Virtual Try-On. The Digital Wardrobe allows users to upload and organize images of their clothing items, where the system automatically removes backgrounds and categorizes them. The AI Magic Stylist analyzes user images and preferences to generate personalized outfit recommendations. The 2D AI Virtual Try-On enables users to visualize how selected clothing items would appear on their body by overlaying garments onto their uploaded image. The dashboard uses a card-based layout to ensure easy navigation and an improved user experience.

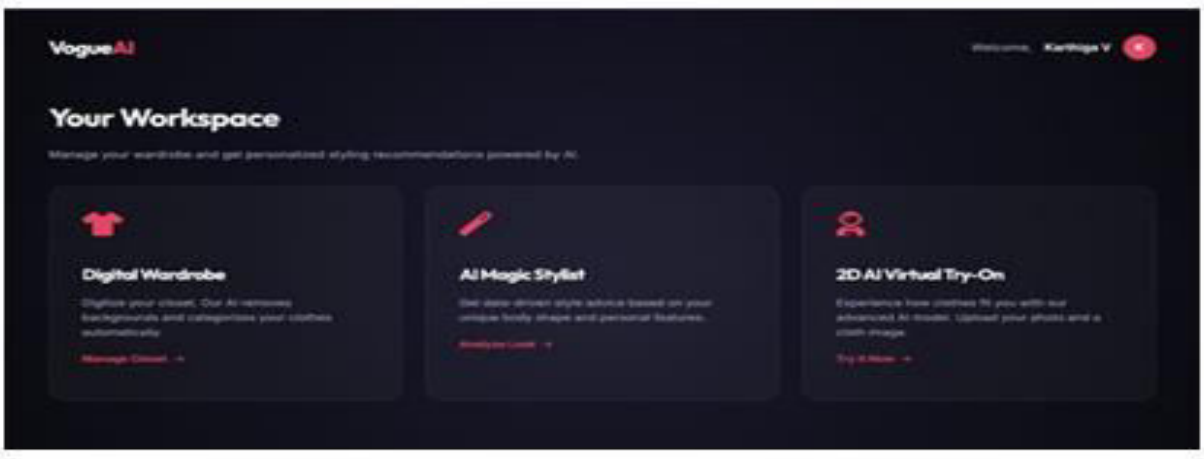

Fig. 6. Main Dashboard

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5.3 AI Magic Stylist Module The AI Magic Stylist module is a key feature of the VogueAI system that provides personalized fashion recommendations using image analysis and user inputs. Users upload a full-body photograph and select options such as occasion, gender, and skin tone to improve recommendation accuracy. The system also offers a Magic Mode that allows users to choose between e-commerce suggestions or custom AI styling advice. After clicking the "Run AI Analysis" button, the AI model analyzes the image and user preferences to generate suitable outfit recommendations using computer vision techniques.

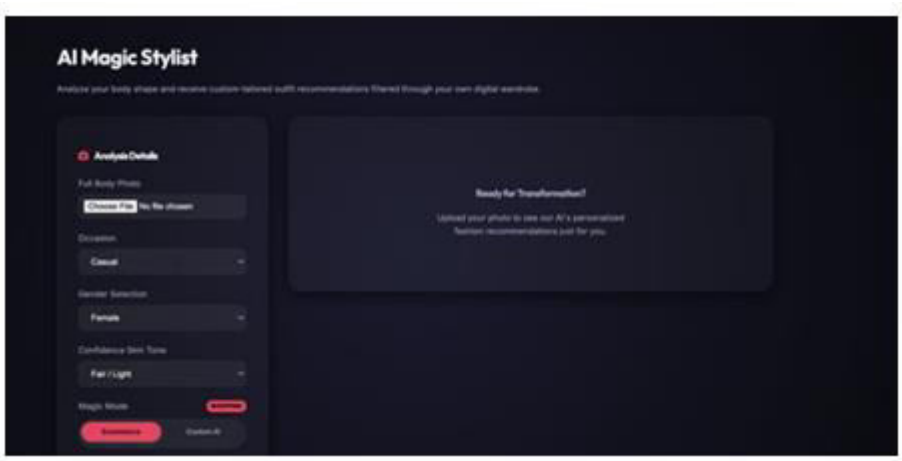

Fig. 7. AI Magic Stylist interface for generating personalized outfit recommendations.

5.4 Digital Wardrobe module

The Digital Wardrobe module allows users to upload and organize clothing items by adding images and attributes such as category, event type, and color. The system processes the uploaded images using AI-based background removal and stores them in a digital collection. This organized wardrobe helps the system analyze clothing items and generate personalized outfit recommendations.

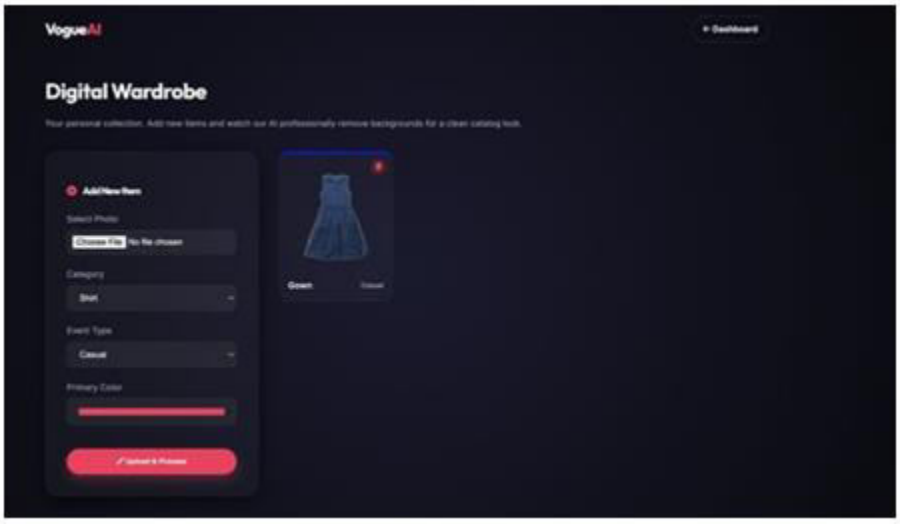

Fig. 8. Digital Wardrobe

The overall results demonstrate that the proposed AI-Powered Personal Style Recommender using Image Analysis provides effective and personalized fashion recommendations. The system successfully analyzes user images along with inputs such as gender, skin tone, and occasion to generate suitable outfit suggestions. The integration of modules like Digital Wardrobe, AI Magic Stylist, and 2D AI Virtual Try-On enables users to manage clothing items, receive AI-based styling advice, and visualize outfits before selection. The system operates efficiently with quick

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response time and user- friendly interaction, indicating that the proposed approach is reliable and practical for real-world personalized fashion recommendation applications.

5.5 Comparison with Existing System

The proposed AI-based fashion recommendation system significantly improves over traditional recommendation approaches by incorporating GAN-based virtual try-on visualization. Conventional fashion systems mainly provide static product suggestions without realistic preview capabilities. Users must imagine how clothing will appear, which often leads to uncertainty and dissatisfaction.In contrast, the proposed system integrates GAN to generate realistic outfit simulations tailored to the user's body structure and pose. This improves confidence in fashion selection and enhances personalization.The GAN-based approach enables dynamic, image-driven recommendations with high visual accuracy.Additionally, the proposed system improves user engagement by allowing interactive styling and visualization. While traditional systems are limited to static catalog browsing, the GAN-enhanced system offers intelligent, AI-driven fashion assistance.Overall, the integration of GAN improves visualization quality, personalization, and user experience compared to conventional fashion recommendation systems.

VI. CONCLUSION

In conclusion, The AI-Powered Personal Style Recommender Using Image Analysis and Deep Learning offers an advanced solution for personalized fashion recommendation. By leveraging convolutional neural networks and similarity matching techniques, the system understands clothing visually and generates coordinated outfit suggestions. The integration of AI improves personalization accuracy, enhances user experience, and reduces decision complexity in online shopping platforms. The system demonstrates the practical application of deep learning in fashion technology. Furthermore, the system can continuously improve its recommendations by learning from user preferences and feedback. This approach also supports the future development of intelligent and adaptive fashion recommendation systems in the e-commerce industry.

VII. FUTURE SCOPE

In the future, the system can integrate real-time virtual try-on using generative adversarial networks to enhance visualization. Expanding the dataset with diverse fashion styles and cultural variations will improve generalization. Reinforcement learning can be incorporated to adapt recommendations based on continuous user feedback. Additionally, mobile application integration and multilingual support will broaden accessibility and user engagement. Integration with social media platforms can also allow users to share and receive feedback on their outfit recommendations. This will further enhance personalization and create a more interactive fashion recommendation experience.

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