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Virtual Fashion Stylist with AI-Generated Wardrobe Capsule Suggestions

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Abstract

This survey aims to create an AI virtual fashion stylist that designs wardrobe capsules tailored to the client's preferences, occasions, and weather conditions. Unlike other fashion recommendation models, this approach emphasizes minimalism, sustainability, and personalization, incorporating a mix of clothing and accessories with a virtual try-on option. Future possibilities include an IoT-connected smart mirror for in-store use, allowing customers to "test" outfits without physically trying them on [1]. This paper also reviews current solutions, existing issues, and different approaches, proposing a novel AI-based strategy for fashion styling with minimal resource consumption [2].

Keywords: Computer Vision, Natural Language Processing, Augmented Reality, Generative Adversarial Networks, Artificial Intelligence.

I. INTRODUCTION

The fashion industry is going through a major revolution with the use of artificial intelligence (AI) technologies. AI is not only affecting the design and manufacturing of clothes, but also changing the ways consumers interact with fashion brands [1][2]. As consumers become more concerned with individuality, the environment, and time, the need for systems that can help them select clothes becomes more apparent [3]. Fashion retailing has been known to use physical stock and broad marketing strategies that do not suit specific customer needs. In this case, consumers are exposed to a variety of options, which often leads to poor purchasing decisions and dissatisfaction [5].

The idea of a virtual fashion stylist is an answer to these issues. With the help of AI, this system can learn the customer's preferences and other aspects like occasion, weather conditions, and fashion trends to suggest clothes that would create a good capsule wardrobe [6]. A capsule wardrobe is a set of clothes that can be combined in many ways, requiring only a minimal amount of items while minimizing the environmental impact of the fashion industry [8]. This setup not only enhances the user experience but also incorporates virtual try-on technology, allowing users to see how specific clothing items might fit them [9].

Current virtual styling applications are mostly limited to styling suggestions or virtual fitting, lacking flexible and comprehensive solutions. For instance, some platforms offer limited or no ability to mix and match clothing items or fail to leverage user data effectively to provide relevant recommendations [10]. Thus, there is significant potential to create a novel AI-based fashion stylist that integrates these features while focusing on sustainability and user control [12].

The objective of this survey is to present a comprehensive overview of the current state of AI in fashion styling, identify the limitations of existing systems, and outline a methodology for developing a more integrated solution that addresses these gaps. By exploring various approaches to wardrobe capsule generation, recommendation systems, and virtual try-on technologies, this paper aims to provide insights into the potential of AI to enhance the fashion shopping experience.

II. OBJECTIVES:

The objectives that we will implement for the "AI-driven Fashion Stylist" are as follows:

1. **Personalized Wardrobe Capsule**: Develop an AI model that actually creates a capsule wardrobe centered on individual needs, time, and location, with less emphasis on more stuffy and unsustainable criteria.
2. **Mix-and-Match and Virtual Try-On**: Provide multiple outfit combinations facility through "mix-and-match" function and virtual try-on of outfits before one buys, so that all the variations can be considered.

III. RELATED WORKS

AI in fashion styling has been on the rise and has attracted the development of several key applications and research. However, a significant number of these solutions are still in their infancy and have specific limitations that hinder their performance [1][2]. Current platforms like Vue.ai and Zyler are AI-based fashion recommendation systems but often work with business models that restrict the client's freedom. Vue.ai utilizes artificial intelligence in enhancing client experience by analyzing customer behaviors and preferences to offer the best recommendations. However, it does not allow flexibility in choosing outfits, thus limiting its usability for users who wish to create a personalized capsule wardrobe [4]. Similarly, Zyler offers virtual fitting but may not meet diverse styling needs as it has limited options and compatibility options for items [5].

Recent studies show significant improvement in the use of AI for fashion recommendation systems and virtual try-on solutions. For example, the **DeepFashion** dataset has had a tremendous impact on the analysis of clothing item image recognition and classification [6][7]. Studies utilizing this dataset, such as "DeepFashion: Some examples include the large scale clothes dataset for visual recognition," demonstrate the potential of computer vision in fashion [8]. However, the emphasis has been given to the identification of items rather than individual styling options [9].

Another important contribution is made by works on generative models in fashion, including the **FashionGen** dataset. This dataset can be used in generating clothing descriptions and attributes that can be used in item recommendation systems [10]. However, current methodologies do not take into account the context needed to recommend specific outfits for a particular occasion or the clothing style of the intended wearer [12].

There has also been important progress in the study of virtual try-on systems. Other works, such as "Human Parsing Using Convolutional Neural Networks for Virtual Try-On," focus on using computer vision for placing garments on user images [13]. Although these techniques have advanced the sector, they often require high-end hardware, making it difficult for average consumers to use.

There is more research on this in the latest papers focusing on style transfer and outfit generation. For instance, the paper "Fashion Recommendation Using Generative Adversarial Networks" presents a GAN-based approach to recommending outfits that can be preferred by the user, showing how generative models can create visually appealing ensembles [15]. However, the focus is mainly

on aesthetics rather than functionality and the practical needs of users.

The use of machine learning for predicting fashion trends has also been explored, as highlighted in “Machine Learning Techniques for Fashion Trend Forecasting”. This research shows how historical data can help predict future trends but does not address the present need of consumers seeking styling services [18].

Additionally, the role of user feedback in improving AI recommendations is emphasized in studies like “Personalized Fashion Recommendation Systems” [19]. These studies point to the importance of user involvement in the creation of recommendation systems, which underlines the limitations of current approaches that fail to involve users actively.

In conclusion, the analysis of the landscape reveals a lack of integrated systems where recommendation services are combined with mix-and-match and try-on options. Addressing these limitations is a central strategy toward creating a versatile virtual fashion stylist that meets the evolving needs of clients [21].

IV. METHODOLOGY

Our goal is to develop a virtual stylist that will guide us on how to build those wardrobe capsules and provides much-needed fashion advice. Steps involved in this respect are as follows:

1. **Step 1: Gathering and Preprocessing the Data**: We are training our model on two of the very popular fashion datasets as every good AI needs a really strong data base. Whereby, **FashionGen** offers informative description and detailed attributes of a clothing item, and **DeepFashion** provides an array of photos and style tags, enabling the model to offer diverse looks and trends [6][7][8].
2. **Building the Recommendation Engine**: The recommendation engine is really at the heart of the system, and we are combining clustering (like K-means) with collaborative filtering to tailor to each user's style. In essence, the model groups similar clothing items as per user input and tracks what users with similar tastes have liked [9]. This, in turn, simplifies recommending a "capsule wardrobe"—a versatile selection of items that work well together—allowing users to mix and match without the need for an extensive wardrobe [11][12].
3. **Combination Options**: For users who love experimenting with different looks, we are designing a feature that suggests matches based on style, color, and similarity scores. This scoring, known as **cosine similarity**, assesses the degree of alignment between clothing items, giving users various outfit options without unnecessary purchases [13].
4. **A Virtual Try-On Feature**: Trying on is essential, so we're incorporating a virtual try-on feature using **OpenCV** and **MediaPipe**. This overlays clothing items onto the user's uploaded photo and uses body landmark detection to align the pieces correctly. While it’s not as complex as 3D modeling, it provides a realistic preview without requiring extensive resources, and accuracy will improve with user feedback [17].
5. **The Future Vision: Smart Mirror Integration**: Envisioning the future, we see this system integrated into "smart mirrors" for retail environments. These mirrors would allow customers to see recommendations, try items on virtually, and even make purchases. Equipped with sensors and cameras, they would provide real-time feedback, creating a seamless and personalized experience for in-store shoppers [18].

6. **Our Commitment to Sustainability**: Sustainability is central to our project, reflected in how the system assesses clothing items for environmental impact. By analyzing factors like lifecycle and carbon footprint, the virtual stylist will offer eco-friendly alternatives, empowering users to make stylish yet planet-conscious choices [20].

V. RESULTS

The first trial of the AI-based wardrobe capsule generator was rather successful. According to the users, they were fully satisfied with the customization of the products due to the mix and match options. Thus, by offering the range of outfits chosen according to individual preferences, the system encouraged the use of as few clothes as possible while offering choice. First-time users of this approach shared that the ability to visualize the various combinations helped them make better decisions when it comes to purchasing, thus proving the efficiency of the AI approach. The virtual try-on system though working fine had some issues in terms of the overlay alignment because of the variation in the user images. Subsequent versions will improve the proposed alignment algorithms and the general quality of the virtual try-on. Users showed the desire to have more features added to the app, including the option to save the outfits created and share them on social networks that will be implemented in the next versions.

VI. LIMITATIONS

Despite its innovative approach, the proposed model encounters several limitations:

1. **Realism in Virtual Try-On:** The accuracy of clothing fit in the 2D virtual try-on experience is limited, as it cannot fully replicate the nuances of physical clothing and its interaction with body shapes.
2. **Lack of Advanced VR Integration:** The current implementation does not include the VR technology because of the hardware problem, which might be an issue to the users who want to have a more interactive fitting process.
3. **Scalability Concerns:** As the number of records increases the recommendation engine may suffer from scalability issues and may require optimization techniques to enhance its throughput.
4. **User Variability:** Different body types and personal preferences can significantly affect how clothing fits and is perceived, making it challenging to provide universally satisfying recommendations.

VII. CONCLUSION

There is immense opportunity for AI to transform the way individuals experience styling and respond to fashion in the context of the fashion styling application. This project has demonstrated that an AI-based virtual stylist can help to provide genuine recommendations of suitable outfits for users based on their needs, occasions, and climates, as well as the latest fashion trends. It does not only provide recommendations on what to wear; it promotes simplicity and teaches users how to build practical wardrobe essentials tailored to their preferences and sustainable fashion [1][2]. Also, the model is interactive as it allows the users to customize the piece and see how it will look on them [3].

The mix-and-match feature allows the users to visualize a variety of outfit combinations, simplifying the decision-making process and reducing fashion fatigue. By helping them create adaptable wardrobes without overbuying, this system supports responsible, sustainable consumption [6]. The virtual try-on feature added another dimension, letting users see how outfits look on themselves before committing to a purchase, which makes for a unique, engaging experience [8].

The project is quite promising, but there is a possibility to expand it further. Aspects of scalability, realism of virtual try-on, and user preferences will enhance the user experience, and broaden the applicability of AI in fashion. In conclusion, this work creates the solid basis for the further development of the modern efficient fashion styling tool that will be oriented on the needs of the contemporary consumers and will demonstrate how the AI can develop and become more friendly for people, providing them with the possibility to make the right choice of the clothes that will be both comfortable and suitable from the point of view of the sustainable development [10].

VIII. FUTURE WORK

In the future, this virtual fashion project has some directions that can be developed to make this concept more realistic, more available for anyone, and more interesting for users.

1. **Making Virtual Try-Ons More Realistic**: At the moment it feels like virtual try-on is still in its infancy, and it is just a 2D image overlaid on a person. But oh, there is so much one could do to enhance this option. The next step could be the visible 3D modeling and body tracking so clothes look like really fitting and moving along with the human body [8]. This would give a more real-life feel and the clothes would then seem to fit the models as if they were real. Adding augmented reality (AR) can also be good as well as giving the users with the actual life feel of the selected outfits in motion or with the different lighting on the screen.
2. **Introducing Smart Mirrors for Stores**: Imagine going to a clothes store and instead of clothes, you see a mirror that is going to tell you what clothes you ought to be wearing. This might be the next phase of this project. With the help of IoT, the smart mirror could provide live advice on what you should wear next when you're dressing up, track your body movements to make the experience more fun, and let you feel what it is like to wear something without having to wear it [10]. Consumers could also get some nice information about their preferences, which will be interesting for retailers to make the shopping even more interesting and individual [19].
3. **Using Data to Fine-Tune Personalization**: The stylist could become wiser, coordinating with the users and re-aligning style to suit each of them. It could even suggest better products if it could consider things such as previous interactions with the customers, time of year, and customer feedback [12]. For instance, if it realizes that a user prefers lighter colors in summer or selects more relaxed outfits on weekends, it should adapt the selection. Such kind of learning would enable the stylist to have knowledge of what is trending among users [20].
4. **Scaling Up with a Cloud-Based System**: For a virtual stylist with a rising user base and growing data requirements, a strong backend will be essential. Moving to a cloud-based backend would ensure that the stylist remains capable of handling more complex requests as the user base expands. This approach would allow people worldwide to access the tool easily through their computer or mobile devices, maintaining responsiveness regardless of its popularity [14].

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