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CELESTE: DEEP LEARNING BASED VIRTUAL TRY ON

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Original Article

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Abstract

Nowadays there is a high rate of returns of purchased products in digital shopping due to inability to experience the outfit and as well as lack of efficiency in regular product searching methods. We proposed an AI-powered online platform for buying clothes which combines deep learning and image processing. This platform consists of a try-on module which overlays clothing on user photographs virtually while satisfying the visual accuracy in terms of lighting, shape and texture. The cosine similarity is used for searching a product, which also enables image and text-based search through a VGG based model. The React Native and Expo is used for designing the application for constant cross-platform interaction, whereas MongoDB and Prisma is used to provide high scale data handling. This application enhances user experience with personalized recommendations through virtual try on , reducing the search overhead, and integrating digital convenience and in-store customer engagement.

Keywords: Virtual Try-On, VGG-Based model, AI-powered online platform, Deep learning, Image processing, Cosine similarity, Cross-Platform, React Native & Expo, MongoDB with Prisma ORM.

Introduction

Digital shopping has wide spread in recent days which is bridging the gap between digital convenience and in-store customer engagement, but many customers face some difficulty in understanding the patterns of the clothes and deciding what to select for the purchase, which often leads to high product returns, dissatisfaction.

To overcome these difficulties, this application introduces an AI powered platform which makes the shopping experience more personalized and interactive. This system allows the user to search for his desired outfit with image and as well as text and also try those outfits virtually through their own images for checking suitability of that particular outfit. This application enhances the confidence in digital purchases by reducing the search time and bringing the feel of in person shopping experience with the user friendly design.

Literature Survey

A lot of improvements have been made in AI powered shopping to increase the online shopping experience. Some traditional e-commerce websites are totally based on keyword-based searches and static product images, which can result in low customer satisfaction. Few programs have used visual APIs for product searches and recommendations [14], but they often lack in accurate customization. Some studies have introduced fashion datasets for clothing and retrieval which focused more on large scale data and rich annotation with fashion images [14]. Furthermore, a virtual try on systems included with pose estimation and image warping algorithms [14],[14], but many of these technologies struggled with complex pose estimation with garment alignment. Some recent advances introduced analysis of diffusion models, categorizing the pose estimation, geometric matching, resolution [14]. The virtual try on techniques uses OTT Diffusion technique as a solution to get a photorealistic try on result while maintaining garment details. These techniques classified as 2D warping,3D modeling and Diffusion based synthesis [14].

Despite these advances, the existing systems fall short of providing accurate user-friendly systems which can combine search and try on functionality. To overcome these, the proposed solution combines deep learning based virtual try on resulting in personalized buying experience.

Proposed Approach

The proposed system is a mobile based application for online fashion shopping for clothes which aims to enhance the shopping experience through virtual try on features. It allows the users to search for matching products using image and text inputs and also try those outfits for better appearance and decision making for purchases. The major functionalities are garment visualization, constant user engagement, search capability, cross-platform interoperability. This platform is integrated with the deep learning models which provide realistic virtual try on clothing suggestions, eliminates uncertainty in shopping, reduces the return rates, and also provides rich online fashion experience.

System Architecture

The system architecture follows a structured request initiating from the user by using a set of pages like home page, search page, virtual try on page, and checkout page. These incoming requests are distributed fairly across the backend sources. After reaching backend,Author is used to perform user authentication and then this information is stored in Redis for fast retrieval of session data. Upon successful authentication then the request is redirected to the appropriate core services based on type of request.

The search request is handled using Elasticsearch for fast and effective product search. This search is given to machine learning models to provide personalized recommendation. The other services of the application like cart, wishlist, order and payment are managed with Postgres databases for higher reliability and consistency. A message queue called RabbitMQ is used to have Asynchronous communication between the components of the applications. The overall architecture is designed to be fast, secure and scalable for digital experience.

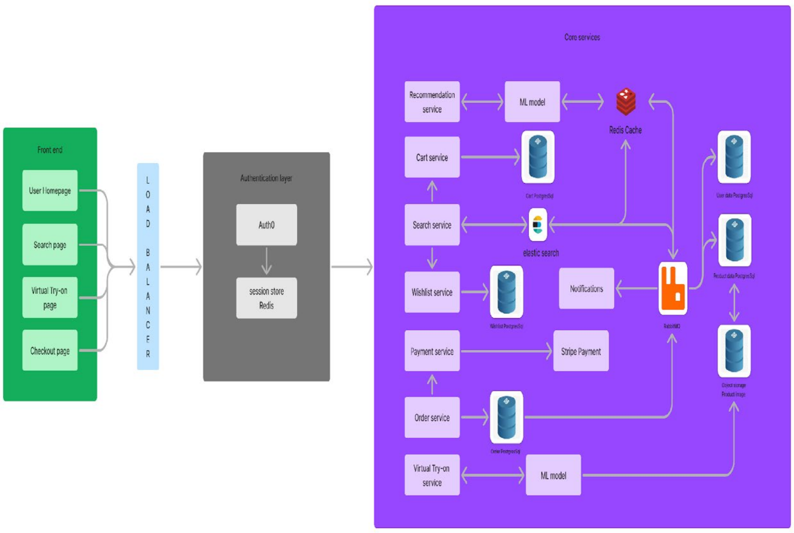

Figure 1: System Architecture

Methodology

The virtual Try on system was designed to provide constant user experience, dynamic pose management and garment overlay in a realistic way. This technique starts with getting requirements in terms of user image as inputs, the React is used for designing an interactive frontend to submit photographs, search for various clothes, and get some outcome out of that activity. Mongo DB and Prisma Structure is used for data storage as a backend, while deep learning-based pose estimation is used for posture flexibility.

To Improve the AI powered shopping experience, we have selected two key deep learning algorithms: VGG Model and OTT Diffusion API. The execution begins with the image search, VGG Model is used to produce a similar image for the user input image using cosine similarity and then virtual try on function is used to show how the outfit apparel on to the user image using OTT diffusion API. This step helps the user to make a decision whether to buy the product or not, which also improves the shopping experience.

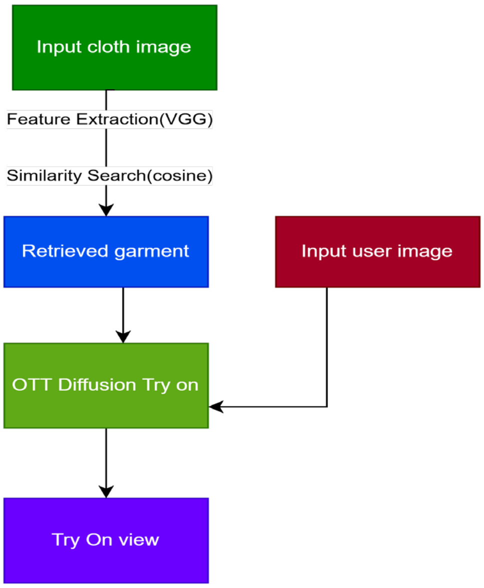

Figure 2: Virtual Try on system

The procedure is explained in two steps

VGG-Based Image Search Workflow

- The VGG model is used to process each product image and extracts features, stores them in the database.
- When a user uploads an image, the model generates its embedding for comparison.
- The system applies cosine similarity comparison between the user's embedding and stored product embeddings.
- The most similar products are retrieved and displayed to the user.

OTT Diffusion-Based Virtual Try-On Workflow

- The user uploads a picture of them to try on the matched apparel.
- The model processes the selected outfit and aligns it with the user's body.
- The model applies diffusion-based rendering to blend the garment onto the user's image realistically to preserve body shape, texture.
- The Outcome is displayed, allowing the user to experience the outfit virtually.

Results & Discussion

Experimental setup:

The Experimental setup involved the configuration of Ubuntu 22.04 and Windows 10. The interactive frontend is designed with React, while Prisma is used for backend architecture. The Mongo DB is used to handle user profiles and clothing related information. Python based machine learning frameworks are employed for garment warping and pose estimation. Diffusion based models are used to enhance the accuracy of virtual try on models. The collaborative development and version control is supported with Git and GitHub.

Results:

The Virtual Try-On technology enables the users to visualize themselves in different clothing through realistic overlays and dynamic pose alignments. The experimental evaluation showed good accuracy in cloth alignment, pose matching, and also demonstrated effective data handling with fast response.

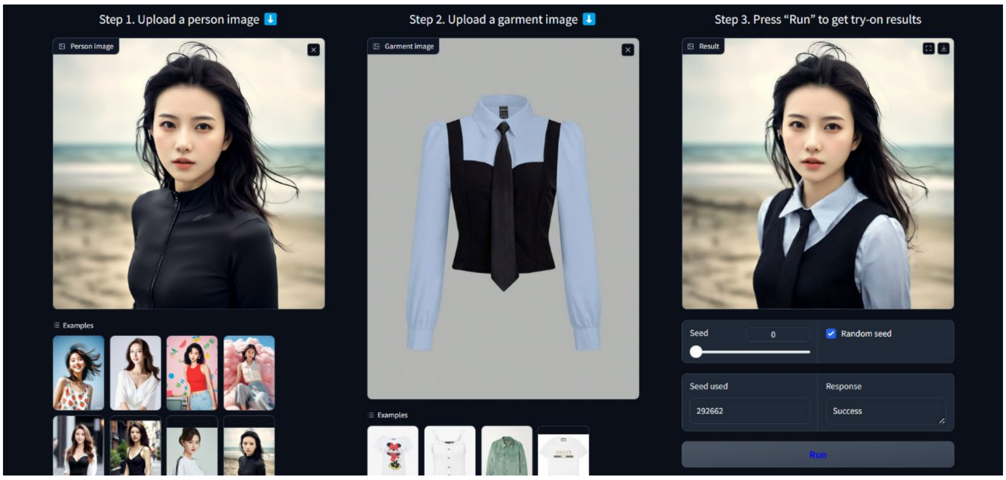

Figure 3: Virtual Try on Result-1

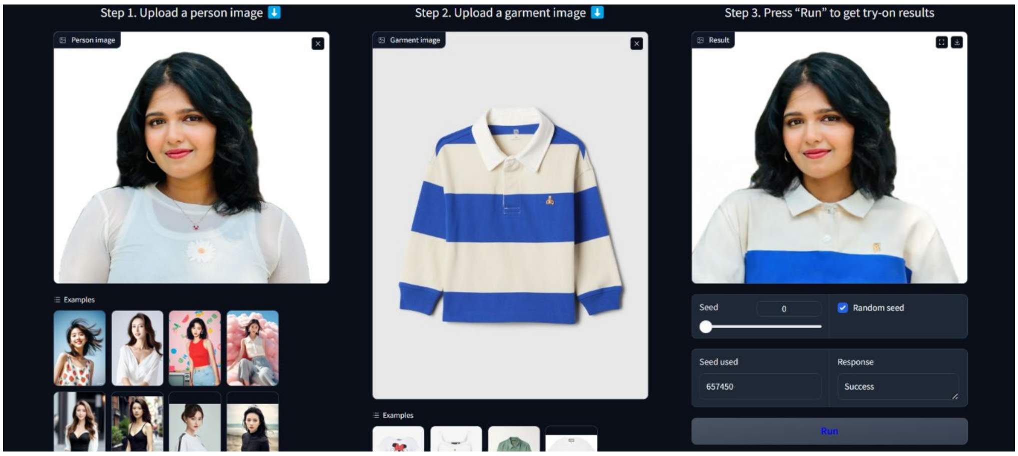

Figure 4: Virtual try on Result-2

The proposed method successfully integrated advanced deep learning models with an interactive graphical user interface to enable user friendly fashion recommendation with virtual try on platform. The VGG model was used for image search, while OTT diffusion API was used for producing virtually realistic garments. Incorporating MongoDB and Prisma enhanced data management and search performance. Furthermore, The cross-platform interoperability with React Native and Expo improved accessibility.

Evaluation Metrics:

The Quality of the generated try on images is evaluated based on the three major metrics those are The Structural Similarity Index (SSIM), The Peak Signal-to Noise Ratio (PSNR) and the Learned Perceptual Image Patch Similarity (LPIPS). The SSIM was selected because it considers the structural properties like brightness, contrast and as well as perceptual similarity between the generated images and original image. PSNR was used for measuring signal-to noise ratio between generated and original images, while LPIPS is used for capturing perceptual differences based on deep feature representations.

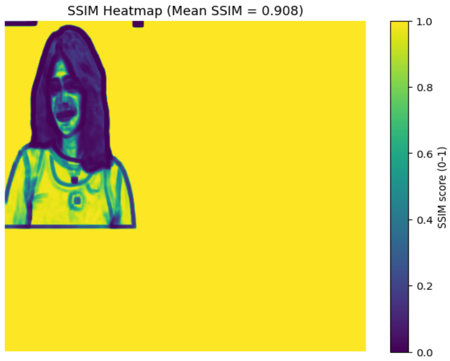

Figure 5: Heatmap for SSIM

We evaluate the quality of try-on results using standard metrics. The table below shows scores of each metric:

Table 1: Evaluation metrics

Metric	Purpose	Range	Good value	Estimated value	Interpretation
SSIM	Image structure similarity	0-1.0	>=0.80	0.908	Structured Similarity
PSNR	Pixel-wise accuracy	10-50	>=25	25.58	Measures image quality
LPIPS	Perceptual similarity	0-1.0	<=0.20	0.20	Perceptual similarity using deep features

Comparison with Existing Platforms

Table 2 presents a comparative analysis of the proposed solution, Celeste, against the capabilities of leading e-commerce systems. Celeste uniquely integrates the visual search, virtual try-on, real time previews, and personalized garment matching within a unified framework. Whereas existing platforms typically lack try-on capability and rely simply on overlays. This Comparison highlights the importance of advances in AI driven systems to deliver functional improvements and as well as more engaging user experiences.

Table 2: Comparison with existing platforms

Feature	Myntra	Amazon	Zara	Ajio	Celeste
Virtual Try-On	**Yes**	**No**	**No**	**No**	**Yes**
Personalized Recommendations	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Visual/Image-Based Search	**Yes**	**Yes**	**No**	**No**	**Yes**
Real-Time Preview with User Image	**No**	**No**	**No**	**No**	**Yes**
Outfit Matching & Style Pairing	**No**	**No**	**No**	**No**	**Yes**
Integrated Shopping Experience	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

Conclusion

The Proposed Virtual Try-on System effectively manages the gap between the physical and online shopping by enabling realistic garment overlays and smart product recommendations. The usage of Deep learning models, scalable architecture and streamline backend process improves the user experience and decision-making process. The integration of VGG based image search and ITT Diffusion models demonstrates the potential for combining computer vision and generative AI in retail applications. Although further improvements in real time performance and personalization remain possible, the proposed system is an initiation towards lower return rates and more user satisfaction in fashion e-commerce. Future work may focus on pose transfer and multi garment compatibility to further extend the system's applicability.

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