Cloth segmentation, styling and pose transfer for different body types

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Abstract

Recent years have witnessed the increasing demands for online shopping for fashion items. Despite the convenience online fashion shopping provides, consumers are concerned about how a particular fashion item would look on them when buying apparel online. Thus, allowing consumers to virtually see how the clothes look on different body types will enhance the shopping experience, transforming the way people shop for clothes. The aim of this project is to take a piece of clothing and virtually put on those clothes on different body types to help with this issue.

1. Introduction

1.1. Motivation

This pandemic saw an increase in online shopping due to mobility restrictions. Ordering something with a click from anywhere and getting it delivered wherever you want is a luxury that saves a lot of time and effort. However, one major challenge is wondering how the product would look on us. This served as the motivation for this project. This project will help us try different clothes on different body types with different poses. We believe this will solve one of the significant issues with online shopping and help increase its reach, comfort, and accessibility.

1.2. Updated Problem Statement

Using our project, we aim to solve the problem of imagining ourselves in clothes. We are trying to develop a system that segments clothes from images, styles them by allowing them to picture themselves in the custom input cloth, and applies pose transfer techniques to get different poses that output on different body types. For this deadline, we developed a process that segments the clothes, allows custom input for cloth to try other garments virtually, and uses a pose transfer technique to get the desired result.

1.3. Challenges Involved

- While obtaining the cloth mask from different images from the dataset, the hair could be present on top of the dress. In that case, transferring the dress from one pose to another could lead to mismatches because the algorithm fails to determine what could be present in the location where hair was present on top of the dress.
- Transferring initial poses to complex poses could lead to unclear output poses or being transferred improperly because the poses are rarely present in the dataset.

2. Updated Related Work

- **Paper 1** [1]: In the paper by Han Yang, Ruimao Zhang, Xiaobao Guo, Wei Liu, Wangmeng Zuo, Ping Luo, Harbin Institute of Technology, SenseTime Research, Tencent AI Lab, The University of Hong Kong, Adaptive Content Generating and Preserving Network(ACGPN) are used for virtual try-on. This method is especially effective for complex poses or poses with hidden body parts. The working is a little different as it first considers the overall structure of the image to be changed and then accordingly decides to generate or preserve image content. In short, it first looks at the layout of the reference image, then the new cloth is wrapped according to this, and lastly, all this information is put together to get the desired output.

- **Paper 2** [2]: This paper by Xintong Han, Zuxuan Wu, Zhe Wu, Ruichi Yu, and Larry S. Davis presents an image-based Virtual Try-On Network (VITON)

without using 3D information that claims to transfer the desired clothing item onto the corresponding region of a person using a coarse-to-fine strategy. A coarse sample is first generated using six convolutional layered multi-task encoder-decoders conditioned on a detailed clothing-agnostic person representation. The coarse results are further enhanced with a refinement network that learns the optimal composition. The model fails when applied to rarely-seen poses or when there is a huge mismatch between current and target clothing shapes.

- **Paper 3** [3]: This paper by Aiyu Cui, Daniel McKee, and Svetlana Lazebnik proposes a flexible person generation framework called Dressing in Order (DiOr), which supports 2D pose transfer, virtual try-on, and several fashion editing tasks. They represent each person as a (pose, body,{garments}) tuple. For the implementation, they ran an off-the-shelf human parser on the source garment to obtain the masked garment segment. To perform pose transfer, they set the body image and the garment set to be those of the source person and render them in the target pose. This method also has some limitations and failures. The complex or rarely seen poses are not always rendered correctly, unusual garment shapes are not preserved, some ghosting artifacts are present, and holes in garments are not always filled in properly.

- **Paper 4** [4] : In this paper by Zhen Zhu, Tengteng Huang, Baoguang Shi, Miao Yu, Bofei Wang, and Xiang Bai on progressive pose attention transfer for person image generation, Pose-Attentional Transfer Blocks were used for transferring poses. They consider the appearance features along with the pose using progressive pose transfer. Further, a Pose-Attentional Transfer Network is proposed to make this process efficient and straightforward that can be extended to non-rigid bodies. Two datasets are used, along with a new metric specifically designed to evaluate the shape consistency.

- **Paper 5** [5]: In the paper Yining Li, Chen Huang, and Chen Change Loy take the source and target image and first use a variant of u-net to encode the image and target pose. Then using the reference and target pose, a 3-d flow map is created. To get an image in target pose, the features of the reference image are warped through a 3-d flow map and then to a visibility map. A visibility map is created to consider the lost pixels due to occlusions. Then concatenating the warped image features and target pose features take place to obtain the pose-transferred image.

- **Paper 6** [6]: In the paper by George. A. Cushen and Mark. S. Nixon, they present a real-time clothing segmentation model for video and single images. It initializes points on the upper body clothing instead of detecting the face of the subject using distance metrics which is advantageous because it helps prevent skin segmentation instead of clothing. It takes advantage of intensity and hue histograms for efficient segmentation.

3. Methodologies

3.1. Techniques/Algorithms

The first step of the problem would be segmenting the clothes from the human body, which we can perform with the help of Adaptive Content Generation and Preservation Network (ACGPN), which keeps clothes and humans intact. We can also use pre-trained U-2-Net models for cloth segmentation and Saliency Map Generation, which accurately segments cloth components based on upper body cloth, lower body cloth, full body cloth, and background. We will use neural networks style transfer for style transfer in the segmented region cases. For cases where the transfer of a single segment of cloth is required, we will use the GAN G1, G2, and G3 to create the pose map, synthesized map, and finally transfer the segmented cloth on the input image. Finally, we will use the saliency full body map and the map with the new cloth/style transferred to perform blending to smooth out the edges S, which will blend the style transferred image with the Saliency map created using U-2-Net. For pose transfer, we plan to use the pose transfer algorithm from DiOr on different body types images obtained from clothes segmentation and wrapping.

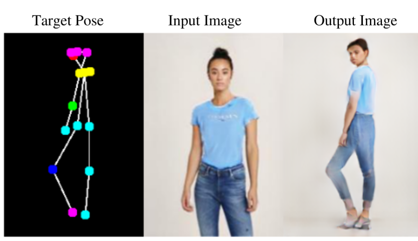
Accordingly to the updated literature review, we found that ACGPN was better than VITON as it can preserve more complex poses as well as poses where everything is not visible; for example, the half-arm isn't visible clearly due to the tilted posture obtained by putting hands in the pocket(sample output is provided in the document in the output section). Next, we found that using DiOr is better than using attention blocks because it puts garments in order. Therefore it is better to handle inputs with layering(overlap of different clothes). It also offers the chance to perform further editing to improve the output quality.

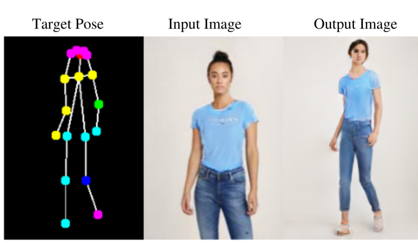
3.2. Output

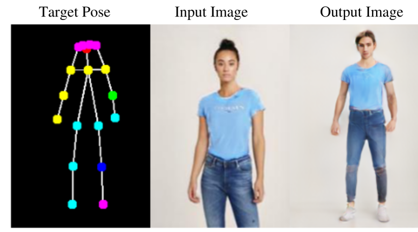
This project consists of two steps, the first step is virtual try-on, and the second stage is pose transfer. In the virtual try-on stage, we input the cloth image and target body and get the output image as the target person wearing the input cloth. The output from the virtual try-on stage is then passed to the pose transfer step as input. This step generates output incorporating various poses.

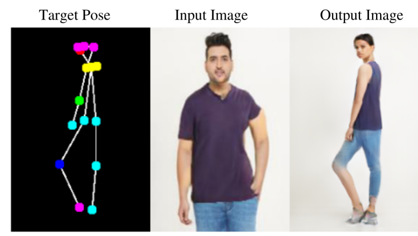
The output for the virtual try-on step is shown below.

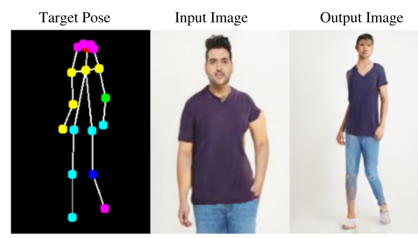
There are a total of 40 different poses, and 40 different images are created with that pose. A few poses and outputs for the pose transfer step are shown below.











3.3. Result Analysis and Evaluation

We can compare the initial image with the final output to see which features change through the various stages, particularly how the initial image remains intact after the final output. We can evaluate the models based on the clarity of pictures formed primarily for regions where a

portion of the image is replaced, like hair and smoothness for edges.

4. Potential Contributions

We have successfully built a technique wherein an input image and input cloth, when taken, will generate an output of the human wearing that piece of garment. This implies that the initial stage of virtual try-on is complete. In the next deadline, we aim to move to the next stage of expanding it for different body types.
All the group members contributed equally and worked collaboratively to achieve this project milestone successfully.

References

[1] Yang, H., Zhang, R., Guo, X., Liu, W., Zuo, W., & Luo, P. (2020). Towards photo-realistic virtual try-on by adaptively generating-preserving image content. In *Proceedings of the IEEE/CVF conference on computer vision and pattern recognition* (pp. 7850-7859)..

[2] Han, Xintong, Zuxuan Wu, Zhe Wu, Ruichi Yu, and Larry S. Davis. "Viton: An image-based virtual try-on network." In *Proceedings of the IEEE conference on computer vision and pattern recognition*, pp. 7543-7552. 2018.

[3] Cui, Aiyu, Daniel McKee, and Svetlana Lazebnik. "Dressing in order: Recurrent person image generation for pose transfer, virtual try-on and outfit editing." In *Proceedings of the IEEE/CVF international conference on computer vision*, pp. 14638-14647. 2021.

[4] Zhu, Zhen, Tengteng Huang, Baoguang Shi, Miao Yu, Bofei Wang, and Xiang Bai. "Progressive pose attention transfer for person image generation." In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, pp. 2347-2356. 2019.

[5] Li, Yining, Chen Huang, and Chen Change Loy. "Dense intrinsic appearance flow for human pose transfer." In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, pp. 3693-3702. 2019.

[6] , George A., and Mark S. Nixon. "Real-time semantic clothing segmentation." In *Advances in Visual Computing: 8th International Symposium, ISVC 2012, Rethymnon, Crete, Greece, July 16-18, 2012, Revised Selected Papers, Part I 8*, pp. 272-281. Springer Berlin Heidelberg, 2012