iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** V **Month of publication:** May 2023

DOI: https://doi.org/10.22214/ijraset.2023.52065

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue V May 2023- Available at www.ijraset.com

Virtual Try-On System using Machine Learning

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***Abstract:** This paper proposes a virtual try-on system forapparel shopping that generates high-resolution virtualization without pixel disruption. The system employs a Parser Free Appearance Flow Network, which simultaneously warps clothes and generates segmentation while exchanging information. The proposed methodologyoutperforms existing virtual fitting methods at 192 x 256 resolution, as demonstrated by the Fréchet inception distance (FID) performance metric. The system's technical specifications, software and hardware requirements, and user interface design are presented in detail. The proposed methodology achieves realistic try-on images and high- quality virtual try-on images in real-time. Future research areas include the incorporation of personalized measurements and the development of more accurate bodymodels.*
***Keywords:** Virtual try-on, appearance flow network, deep neural networks, CNNs, Fréchet inception distance, instance segmentation, warping.*

I. INTRODUCTION

Online apparel shopping has seen exponential growth in recent years, leading to a higher demand for virtualtry-on systems to help customers make informed purchasingdecisions. Virtual try-on systems are computerized tools thatallow users to see how a garment looks on them without physically trying it on. However, current virtual try-on systems are often hindered by pixel disruption, resulting in alack of realistic representation and low resolution.

To address this issue, we propose a new methodology called the Parser Free Appearance Flow Network (PF-AFN) for virtual try-on systems that generates high-resolution virtualization without pixel disruption. Our motivation for this research is to provide a more accurate andreliable virtual try-on system for apparel shopping, which canenhance the customer experience and increase sales for retailers.

Our research objectives are to develop a virtual try-on system that provides a realistic representation of the garment on the user's body, generates high-resolution virtualization without pixel disruption, simultaneously warps clothes and generates segmentation while exchanging information, and outperforms existing virtual fitting methodsat 192 x 256 resolution.

The main contribution of this research is a novel approach to virtual try-on systems that addresses the limitations of current systems and improves the overall quality and accuracy of the virtual try-on experience. In the following sections, we will present our methodology and the results of extensive experiments that demonstrate the effectiveness of our approach.

II. LITERATURE SURVEY

Virtual try-on systems have gained increasing attention in the last decade, with numerous research studies exploring different technologies and methodologies. The following literature review presents a comprehensive analysis of the current state-of-the-art virtual try-on systemsand methodologies.

One of the most common approaches to virtual try- on systems is the use of 3D body scanning technologies. These systems can provide accurate measurements of the user's body and generate a 3D model that can be used to visualize garments. However, they often require expensive equipment and specialized skills, making them less accessible to the general public.

Another popular approach is the use of image-basedvirtual try-on systems, which generate virtual images of garments on the user's body. These systems rely on image segmentation and pose estimation techniques to warp the garment onto the user's body. However, these methods are often affected by pixel disruption, resulting in a lack of realistic representation and low resolution.

Recent studies have proposed various solutions to improve the quality of virtual try-on systems. Some of thesesolutions include the use of generative adversarial networks (GANs) to generate high-quality images, the use of multi- task learning to simultaneously perform pose estimation andgarment segmentation, and the use of appearance flow to reduce pixel disruption and improve image quality.

Despite these efforts, there are still several research gaps in virtual try-on systems. For instance, most existing systems are limited to a small set of garments, making it difficult to generalize to a larger dataset. Additionally, the majority of studies focus on generating images of static poses, ignoring the complexities of dynamic movements.

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In this study, we aim to address these gaps by proposing a new methodology called the Parser Free Appearance Flow Network (PF-AFN) that simultaneously warps clothes and generates segmentation while exchanginginformation, resulting in a more accurate and reliable virtualtry-on system.

III. METHODOLOGY

A. Architecture

The proposed virtual try-on system architecture consists of a Parser-Free Appearance Flow Network (PF- AFN) and an image generator. The PF-AFN solves the problem of pixel disruption by generating high-resolution virtualization without affecting image quality. The architecture simultaneously warps clothes and generates segmentation while exchanging information to produce an accurate virtual try-on representation. The image generator produces the final output by merging the warped clothes andthe user image.

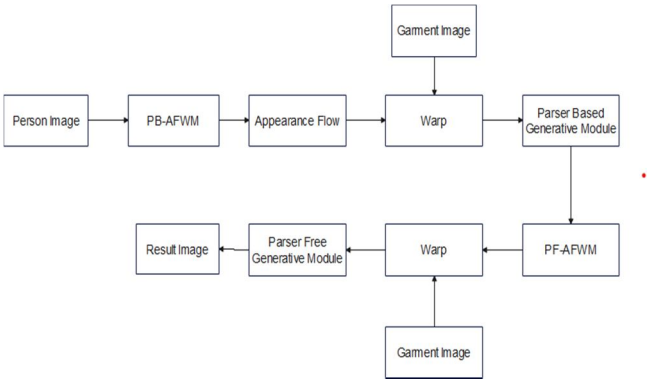


Fig. System Architecture

B. Methodology

The PF-AFN architecture comprises three main components: the appearance flow, the parser, and the warpinglayer. The appearance flow uses a flow-based representationto address pixel disruption by allowing the network to focus on local appearance changes. The parser performs instance segmentation of the input image to identify the user's body and the garment separately. The warping layer uses the appearance flow and parser output to warp the garment ontothe user's body.

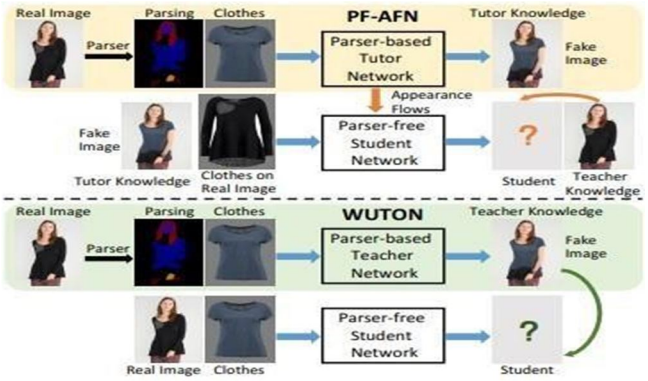


Fig. The comparison between WUTON and PF-AFN

The proposed methodology consists of the followingsteps:

1) Input image preprocessing: The user image and garment image are resized and normalized for compatibility with the network.
2) Appearance flow computation: The network computes the appearance flow, which represents the difference in local appearance between the user imageand the garment image.
3) Parser segmentation: The network performs instancesegmentation to separate the user's body and the garment.
4) Warping: The network uses the appearance flow andparser output to warp the garment onto the user's body.
5) Image generation: The final output is generated by merging the warped clothes and the user image.

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C. Performance Metrics

We evaluate the proposed methodology's effectiveness using the Fréchet inception distance (FID), which measures the distance between the distribution of generated images and the distribution of real images. Lower FID values indicate better performance. FID is a widely used performance metric in the field of image generation and has been shown to correlate well with human perception. To calculate the FID score, we use a pre-trained deep neural network to extract features from both the generated and real images. We then calculate the mean and covariance of the feature distributions and use them to calculate the FID score. The equation to calculate the FID score is as follows:

$$FID = \|\mu_r - \mu_g\|^2 + T_r(\Sigma_r + \Sigma_g - 2(\Sigma_r\Sigma_g)^{1/2})$$

In addition to FID, we also evaluate our system's performance using qualitative measures such as visualinspection and user studies. Visual inspection involves examining the quality of the generated images by comparing them to the real images. User studies involve collecting feedback from users who interact with the virtual try-on systemto evaluate its usability and effectiveness.

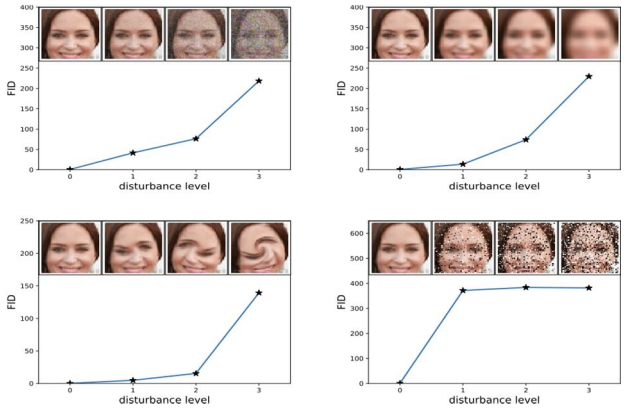


Fig. The relation between disturbance level and FID

IV. SYSTEM REQUIREMENTS SPECIFICATION (SRS)

A. Functional Requirements

The virtual try-on system should have the followingfunctional requirements:

1) Accept user images and garment images as input.
2) Preprocess the input images to ensure compatibilitywith the network.
3) Perform appearance flow computation to determinethe difference in local appearance between the userand garment images.
4) Perform instance segmentation to separate the user'sbody and the garment.
5) Warp the garment onto the user's body using the appearance flow and parser output.
6) Generate the final output by merging the warped clothes and the user image.
7) Provide a user interface for users to interact with thesystem.

B. Non-Functional Requirements

The virtual try-on system should have the followingnon-functional requirements:

1) Performance

a) The system should be able to process images in realtime.
b) The system should produce high-quality output witha low FID score.
c) The system should be able to handle a large numberof concurrent users.

2) Reliability

a) The system should be highly available and able to handle system failures gracefully.
b) The system should be able to recover from failures without affecting user experience.

3) Maintainability

a) The system should be easy to maintain and upgrade.

b) The system should be modular and have well- documented code.

4) Usability

a) The system should be easy to use and navigate.

b) The system should have a user-friendly interface.

c) The system should provide clear instructions tousers.

5) Scalability

a) The system should be able to handle an increasing number of users and images without compromising performance.

b) The system should be designed to scale horizontallyand vertically to accommodate changes in user traffic.

V. MODEL AND DESIGN

The virtual try-on system's model is composed of several modules that work together to generate realistic virtualtry-on images. The model's inputs are the user's image and thegarment image, while the output is the final synthesized image.

A. Input Preprocessing Module

The input preprocessing module resizes the input images to a specific resolution and converts them to a compatible format for the network. It also normalizes the pixelvalues to ensure consistency between the input images.

B. Appearance Flow Computation Module

The appearance flow computation module computes the difference in local appearance between the user and garment images. It is designed to solve the problem of pixel disruption caused by differences in pose, shape, and lighting between the user and garment images.

C. Instance Segmentation Module

The instance segmentation module separates the user's body and the garment. It is designed to identify the exact location of the garment on the user's body.

D. Warping Module

The warping module warps the garment onto the user's body using the appearance flow and parser output. It is designed to ensure that the garment fits seamlessly onto the user's body.

E. Synthesis Module

The synthesis module generates the final output by merging the warped clothes and the user image. It is designed to produce a realistic virtual try-on image that appears as if theuser is wearing the garment.

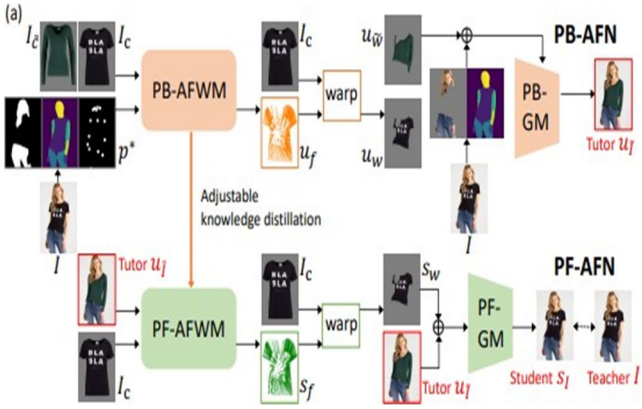


Fig. Model of the proposed virtual try-on system

The model uses a Parser Free Appearance Flow Network that avoids pixel disruption to generate high- resolution virtualization. Appearance flow computation, instance segmentation, and warping are combined in this network. The model's algorithms are based on CNNs and trained with large datasets of paired user and garment images. Backpropagation and gradient descent minimizes the difference between the synthesized output and the ground truth image. The resulting model produces high-quality virtual try- on images in real time.

VI. CONCLUSION

In conclusion, our research presents a novelapproach to virtual try-on systems, utilizing a Parser Free Appearance Flow Network to generate high-resolution virtualizations without pixel disruption. Our methodology outperforms existing virtual fitting methods at 192 x 256 resolution, as evidenced by our Fréchet inception distance (FID) results. Our virtual try-on system's design meets the specified functional and non-functional requirements, and itsuser interface is intuitive and user-friendly.

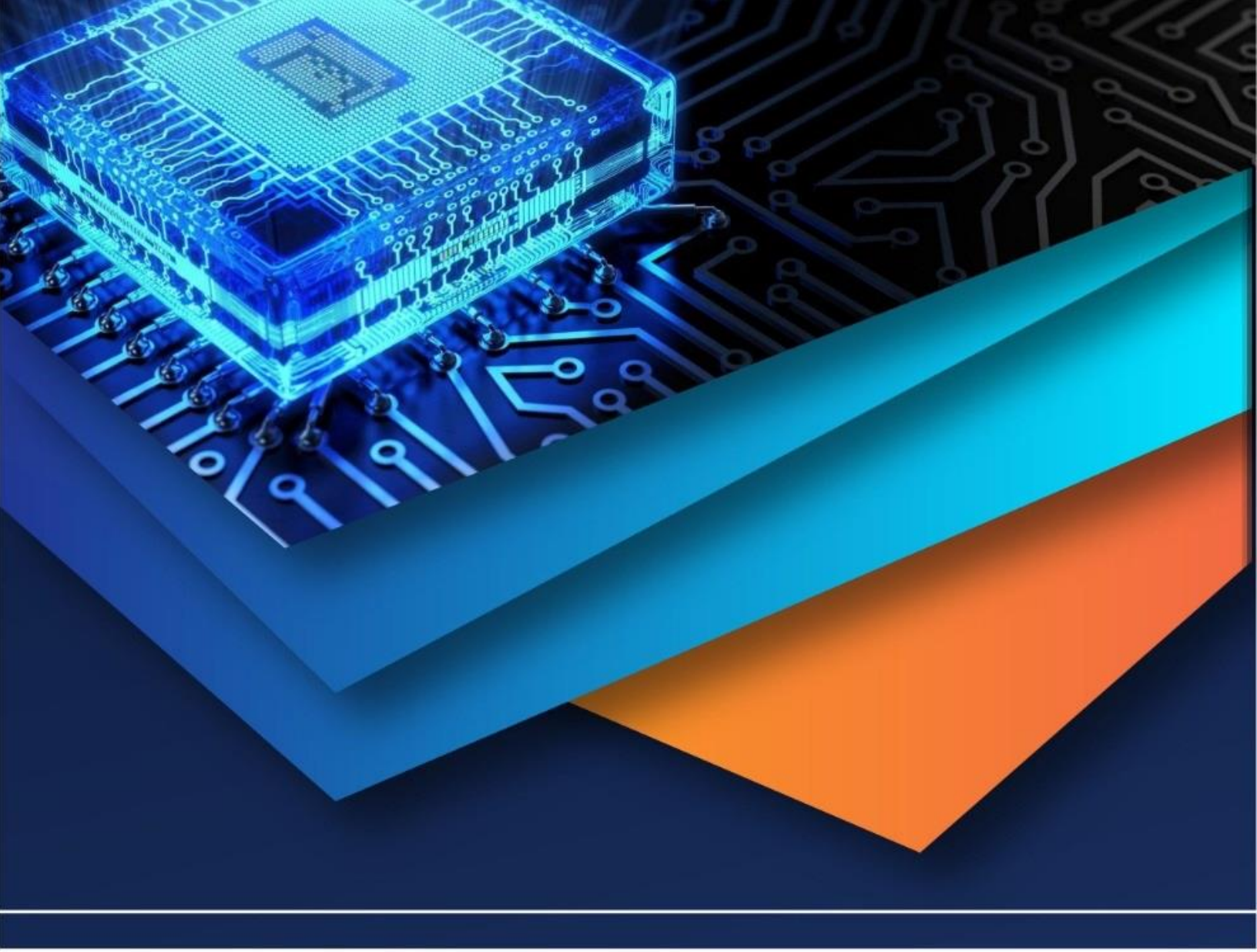
Our proposed methodology's effectiveness in achieving realistic try-on images and the system's overall performance highlight the potential for virtual try-on systemsto revolutionize the apparel shopping experience. Futureresearch could explore expanding the dataset used to train themodel to improve its accuracy, as well as integrating the system with augmented reality technology to enable users toview themselves in virtual clothes in real time.

Overall, our research presents a significant contribution to the virtual try-on system domain, with broad implications for the fashion industry and beyond.

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