Poly-GAN Multi Conditioned GAN for Fashion Synthesis

A PROJECT REPORT

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Declaration

I undersigned hereby declare that the project report titled **"Poly-GAN Multi Conditioned GAN for Fashion synthesis"** submitted for partial fulfillment of the requirements for the award of degree of Master of Computer Applications of the APJ Abdul Kalam Technological University, Kerala is a bonafide work done by me under supervision of Smt. Priya S A, Asst.Professor. This submission represents my ideas in my words and where ideas or words of others have been included. I have adequately and accurately cited and referenced the original sources. I also declare that I have adhered to ethics of academic honesty and integrity as directed in the ethics policy of the college and have not misrepresented or fabricated any data or idea or fact or source in my submission. I understand that any violation of the above will be a cause for disciplinary action by the Institute and/or University and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been obtained. This report has not been previously formed the basis for the award of any degree, diploma or similar title.

Place : Trivandrum **Anju B A**

Date : 12/07/2022

DEPARTMENT OF COMPUTER APPLICATIONS

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CERTIFICATE

This is to certify that the report entitled **Poly-GAN Multi Conditioned GAN for Fashion synthesis** submitted by **Anju B A** to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the Degree of Master of Computer Applications is a bonafide record of the project work carried out by him under my guidance and supervision. This report in any form has not been submitted to any University or Institute for any purpose.

Internal Supervisor External Supervisor

Head of the Dept

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Anju B A

Abstract

Fashion synthesis is a difficult task that involves the placement of a source garment onto a reference garment in any pose that exists in the source garment in its initial state.This model is the first instance where a common architecture is used to perform all three tasks.It allows conditioning on multiple inputs and is suitable for many tasks, including image alignment, image stitching, and inpainting.This architecture enforces the conditions at all layers of the encoder and utilizes skip connections from the coarse layers of the encoder to the respective layers of the decoder Conventional techniques use a pipeline similar to this one, stitching the aligned garment after it has been aligned with the human position, then fine-tuning the results.Additionally, this architecture can perform image stitching, regardless of the garment orientation, and inpainting on the garment mask when it contains irregular holes. The system is implemented using Python with ML .

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Chapter 1

Introduction

E-commerce is changing the world day by day.In 2022, global e-commerce sales will likely reach more than 5 trillion dollars. Online stores enable shoppers to use "search" features to find specific models that they are in need of. People's shopping behaviour is changing quickly too—buying things on the internet is becoming increasingly popular.Online shopping sites enable us to shop from a wide variety of displayed models of clothes. The buyers can choose according to their requirements.It allows to insert virtual objects into an image sequence .The technic pose estimation is used to display garments on shopping sites.This enables the buyers to choose from a variety of models after comparing the finishing features and prices of the products on display,

The technology used in this model is Generative Adversarial Networks (GANs) . It has been one of the most exciting developments in recent years, as they have demonstrated impressive results in various applications, including fashion synthesis.This is a project that implements a single architecture for all three tasks in the fashion synthesis pipeline .

Chapter 2

Problem Defnition and Motivation

Through my project I'm trying to develop a machine learning model which can be used to display garment models on an arbitrary human pose.

Fashion synthesis is a challenging task in the fashion industry that requires placing a reference garment on a source model who is in an arbitrary pose and wearing a different garment .The arbitrary human pose requirement creates challenges, such as handling color spill, self-occlusion or limited availability of training data, as the training dataset may or may not have the model's desired pose.

The major objective the project is to automatically place garment on any pose and through the project try to save the effort and time that we spend on online platforms for the comparison of clothes. And through this project I can assure that the project can achieve it.

Chapter 3

Literature Review

The automated placing of garments in fashion synthesis is a hot area. This can give the customers a better shopping experience and ease of choosing items. As a part of my literature review, I went through various papers and presentations on this topic.

3.1 Using statistical model

Previous methods for realistic cloth modelling mainly deal with the intensive computation of physics-based simulation (with numerous heuristic parameters), while models reconstructed from visual observations typically suffer from a lack of geometric details. So we reconstruct global shape deformations using a statistical model instead of a physics-based simulation and a mapping from pose parameters to blended shape parameters using real-world data. This model can also be used to capture images of clothed people in motion. The major limitation is that high-resolution normal maps can have missing information in areas not seen by cameras, such as armpit areas.

3.2 Using two network approach

This is a model that allows you to virtually try on the garments before purchasing them. The garment transfer problem comprises two tasks: learning to separate a person's body (pose, shape, color) from their clothing (garment type, shape, style) and then generating new images of the wearer dressed in arbitrary garments. It employed course-to-fine networks to generate the image of a person conditioned on a topic of interest. However, since these methods do not use full

body parse information, the resulting images are mostly blurry and, in some cases, unrealistic. The limitation is the performance of the model in cases where the pose of the reference person is complicated, such as when arms and body occlude each other.

3.3 Using text-to-image conversion

The challenge of generating high-quality images from textual descriptions is that the synthesised image should reflect the textual description. Generating high-quality images from textual descriptions is an active research direction in image generation and has aroused a great interest in the fashion industry. The synthesised image should be consistent with the meaning of the text and be of acceptable quality. Two GAN-based algorithms are adopted, namely, Attentional Generative Network (AttnGAN) and Stacked Generative Network (StackGAN). They are applied to two fashion datasets separately, namely FashionGen and Fashion Synthesis.

Chapter 4

Requirement Analysis

4.1 Purpose

On online shopping sites, automatic placement of garments on other garments is a way of displaying items to the customers in a way that is more convenient and easy .The purpose of this project is to develop a system to make it useful for the users.This kind of module will be part of online shopping sites.And we can extend this to a virtual try on.

4.2 Overall Description

Placing a reference garment on a reference garment is a challenging task. It sometimes includes self-occlusion,color spill, or lack of an available data set for training.Previous models make use of three networks for garment generation, stitching, and painting.This model ia able to perform these three tasks by using the same architecture.In this model, the conditioned GAN is used for the generation of a garment, and this garment is used for the stitching and painting purposes.

4.2.1 Product Functions

- stage 1: Generation of garments
- Stage 2: Stitching
- Stage 3: Painting

- Stage 4: Combining the result of Stage 2 and 3 and finally add head back on the garment
- Training the model
- Testing the model

4.2.2 Hardware Requirements

- Processor : Intel Core i3
- Storage : 512 GB Hard Disk space
- Memory : 8 GB RAM

4.2.3 Software Requirements

- Operating System : Linux/Windows
- Platform : Google Colab
- Language :Python
- GPU capacity :8GB
- Librarie used : imgaug,skimg, pandas, matplotlib, numpy, sklearn,Torch

4.3 Functional Requirements

The functional requirements includes all the activities or processes that should be achieved by the system. It includes

- **imgaug:** This library is used for augmenting images.It changes a set of input images into a much larger set of slightly altered images.
- **skimg:** Instead of using an external image, we can simply load a single image from the data module provided within the package to perform a few experiments.This package provides some sample images.

- **matplotlib:** It's used for the visualisation of data in python programming language. It's implemented to work with the wider scipy stack and it's built on numpy arrays. It's a multi platform data visualization technique. It was developed in 2002 by John Hunter. Visualization is the most efficient way to understand the data. Using this library, we can represent our data in various plots such as line, bar, histogram, scatter etc.
- **Torch:**Torch is a Deep Learning tensor library mainly used for applications using GPUs and CPUs.It supports frameworks like TensorFlow and Keras using the omputation graphs.

4.4 Non Functional Requirements

4.4.1 Performance Requirements

- Accuracy : Accuracy in functioning and the nature of user-friendly should be maintained by the system.
- Speed : The system must be capable of offering speed.
- Low cost: This system is very cheap to implement and is also user-friendly.
- Less Time consuming: It uses very less time comparing to the existing sysytem .
- User Friendly: This proposed system is highly user friendly they enables to create a good environment.

4.4.2 Quality Requirements

- Scalability : The software will meet all of the functional requirements.
- Maintainability : The system should be maintainable. It should keep backups to atone for system failures, and should log its activities periodically.
- Reliability : The acceptable threshold for down-time should be large as possible. i.e. mean time between failures should be large as possible. And if the system is broken, time required to get the system backup again should be minimum.
- Availability: This system is easily available as the core equiments in building the sofware is easily obtained.

- High- Functionality: This system is highly functional in all environment since, They are highly adaptable.

Chapter 5

Design And Implementation

This model is used to automatically place the garment on another garment on a arbitrary human pose using a pre-trained model.

5.1 Overall Design

In this project, the automatic replacement of garments is done using Google colab using the internet facility. So there is no interface that a user can interact with to give input to the model. The reference model and source model can be selected by the user by giving the path of the images.The model is built using platforms such as Google Colab and the language used is Python.

5.1.1 Methodology

In this project, there are mainly five stages . The first one is the garment generation using the conditioned GAN. The transformed image is the output of this stage. This output will act as the input to the next stage .For the second stage, the garment passed from the previous stage along with body pose and the RGB skeleton are passed for the purpose of stitching. The third stage is the painting, which involves painting the irregular holes in the garment. Finally, the output of stages 2 and 3 is then combined to get the desired result.Then train and test the generated model to check the accuracy of the model.

The main process of the automated placing of garment is the creation of the trained model. The major steps in the model are Garment generation,stitching,painting, training, testing and

model evaluation. The major steps in the model creation are mentioned below.

Figure 5.1: Architecture of model Creation

- **Stage 1:**Stage 1 is the process of creating the garment using the conditioned GAN.The output of this stage is the input of other stages.
- **Stage 2:**Stage 2 serves the purpose of stitching the transffered garment from the previous stage.
- **Stage 3:**This stage performs the painting on irregular holes from the previous stage.
- **Training:** A portion of our dataset is used for training. The remaining portion is for testing the model.
- **Testing:** In the testing phase, we test the generated model with the remaining portion of the dataset. The data set is fed into the generated model and checking the results

5.2 Data Flow Diagram

DFD is one of the graphical representation techniques used in a project to show the flow of the data through a project. DFD helps us to obtain an idea about the input, output, and process involved. The things absent in a DFD are control flow, decision rules, and loops. It can be described as a representation of functions, processes that capture, manipulate, store,

and distribute data between a system and the surrounding and between the components of the system. The visual representation helps for good communication.

It shows the journey of the data and how will it be stored in the last. It does not provide details about the process timings or if the process shall have a parallel or sequential operation. It is very different from a traditional flow chart or a UML that shows the control flow or the data flow.

In level 0 the basic data flow of the application is showcased. It does not show the flow of data much deeper. It will be evaluated in the higher levels of Data Flow Diagram. The Data Flow Diagram of Poly-GAN Multi-conditioned GAN for fashion synthesis is shown below.

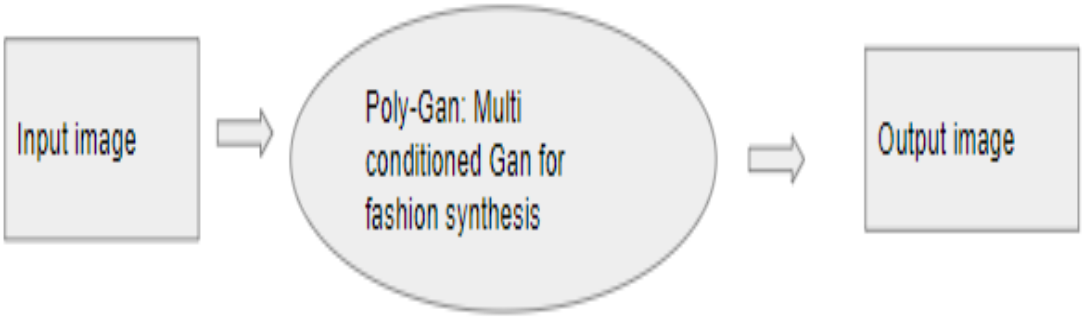

Figure 5.2: Level 0 DFD

The diagram shows Level 0 Data flow diagram of the Poly-GAN multiconditioned GAN for fashion synthesis.As the diagram indicates, we are inputing an image (that is a source model with any pose and a reference garment) to the system, then the image goes under processing (the processes are garment generation, stitching, and painting) applied to the source garment, and finally we get the reference garment worn pose at the end. The user can be able to choose an image from a set image by using the path.

5.3 Screenshots of inputs

Figure 5.3: source image

Figure 5.4: Reference image

Figure 5.5: Output image

Chapter 6

Coding

Algorithm 1 Algorithm for Creating the model:

1: Input two images namely Source garment with arbitrary pose and Reference garment.

2: Split the data set into training data set and testing dataset. 80% of the dataset is used for training and the remaining 20% is used for testing to obtain better result.

3: The training dataset is used for training of the various stages including garment generation,stitching and painting.

4: The model is created using conditioned GAN .

5: The testing dataset is feeded into the created model and their results are noted down.

6: The result of testing dataset evaluated using the created model is then compared with the actual values of the testing dataset to evaluate the efficiency of the model.

7: Further tuning is performed upon the created model to improve the efficiency of the model.

Chapter 7

Testing and Implementation

7.1 Testing and various types of testing used.

Once a software is developed, the major activity is to test whether the actual results match with the experimental results. This process is called testing. It's used to make sure that the developed system is defect free. The main aim of testing is to find the errors and missing operations by executing the program. It also ensure that all of the objectivs of the project are met by the developer. The objective of testing is not only to evaluate the bugs in the created software but also finding the ways to improve the efficiency, usability and accuracy of it. It aims to measure the functionality, specification and performance of a software program. Tests are performed on the created software and their results are compared with the expected documentation. When there are too much errors occurred, debugging is performed. And the result after debugging is tested again to make sure that the software is error free. The major testing processes applied to this project are unit testing, integration testing and system testing. In unit testing, our aim is to test all individual units of the software. It makes sure that all of the units of the software works as it intended. In integration testing, the combined individual units are tested to check whether it met the intended function or not. It helps us to find out the faults that may arise when the units are combined. In system testing the entire software is tested to make sure that it satisfies all of the requirements. The tables shown below describes the testing process occurred during the development of this project "poly-GAN multi-conditioned GAN for fashion sysnthesis". This defines the various steps took to create the project error free.

7.1.1 Unit Testing

Text Cases and Result

Sl No	Procedures	Expected result	Actual result	Pass or Fail
1	training and testing of model	create the model and store it in a pickle file	pickle file generated	Pass
2	prediction	predict the result accurately	same as expected.	Pass

Table 7.1: Unit test cases and results

7.1.2 Integration Testing

Text Cases and Result

Sl No	Procedures	Expected result	Actual result	Pass or Fail
1	pass input source and reference image through code sequence	To pass the input images entered by the user to the python program to and receive it there.	Same as expected	Pass
2	display results	pass the result to the result folder and display it there	Same as expected	Pass

Table 7.2: Integration cases and result

7.1.3 System Testing

Text Cases and Result

Sl No	Procedures	Expected result	Actual result	Pass or Fail
1	to run appliation	program executed successfully, hence the entire program worked without any crash	Same as expected	Pass
2	garment evaluation	allow user to input source and refernce image and output generated according to the input image.	Same as expected	Pass

Table 7.3: System test cases and results

Chapter 8

Results and Discussion

The main aim of the project was to automatically replace one garment model with another with a machine learning model. And it is observed that the system performs all the functionalities as expected. By using this machine learning model, the system can automatically replace the model that the source and reference model can choose from the list of available images.This system takes care of self-occlusion and colour spill to some extent.

8.1 Advantages and Limitations

8.1.1 Advantages

- can save the time needed for the placement of garments.
- A better way of displaying garments.
- It can extend to a virtual try-on, which will help the shopping in a convenient way.

8.1.2 Limitations

- The current dataset is very large, so it takes a very long time to train the model with it.
- Sometimes the result may contain colour spills due to poor training.

Chapter 9

Conclusion and Future Scope

Poly-GAN multi-Conditioned GAN For Fashion Synthesis is a very useful machine learning application for the fashion environment. It assists us in evaluating the garment that you are attempting to purchase while shopping online. Through this project, I tried to develop a machine learning model to place a reference model on a source model and finally wear a different outfit from the initial state. The concept of automatic evaluation of clothes helps us to save the time and effort needed while shopping.

This model suffers from a colour shift due to training the model with a smaller number of epochs, which slightly affects the performance. This can be avoided by training the model with a large number of epochs. This is an efficient tool that will make the shopping sites better and better in the future.

The feature scope of this particular machine learning model can be extended to multiple dimensions. This model can be extended to reconstruct all body parts with sufficient details without occlusions, and apply the method to more diverse types of clothing and accessories like coats, scarfs, footwear,watch.It can be extended to a virtual try-on by using a scanning setup.

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