CP-14 Improving the performance of fashion apparel classification by transfer learning with synthetic data

Abstract

The large size of the training dataset is often required to obtain a robust deep learning model. In the project, we aim to offer a solution to obtain a robust deep learning model with only a small amount of data. We proposed a machine learning scheme that utilizes transfer learning with synthetic data to improve the deep learning model's performance in the fashion apparel classification domain with a small dataset. We apply our schemes on two fashion apparel classification tasks, neckline classification and pattern classification. Our scheme successfully improves the accuracy of the deep learning model and reduces the training time/ computational power to reach such high performance. Our scheme aims to classify the neckline and the patterns on the clothing.

Introduction

As the online clothing retail becoming a major market on the online shopping, many small retailers do not possess tools to properly categorize their products and does not have access to large fashion apparel datasets, therefore they can't take advantage of the well-developed machine learning. In this project, we proposed a machine learning scheme that utilize transfer learning to obtain a robust model with limited resources. Our scheme will help the small online retailer with limited resources, in terms of dataset and computational power, to take advantage of the machine learning tools for their business growth.

Research Question(s)

How to train a robust models when there is only limited amount of data?
How to shorten the training time?
Can we generate synthetic datasets that has same features as the target domain datasets?

Datasets

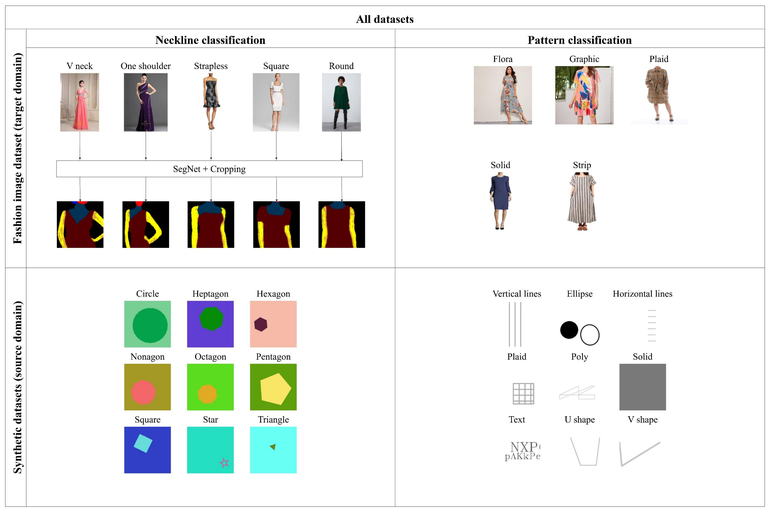

Fig.1 Samples from all datasets used in the project

For neckline synthetic dataset, it consists of 9 shapes: circle, heptagon, hexagon, nonagon, octagon, pentagon, square, star, triangle. We generate 10000 images for each shape.
For pattern synthetic dataset, it consists of 9 pattern: ellipse, horizontal lines, plaid, polygon, text, u shape pattern, v shape patter, vertical line. We generate 10000 images for each pattern.
For the neckline fashion dataset, it consists fashion images categorize into 5 different necklines: one shoulder, round, square, strapless, v neck. Each neckline category has around 1000 images
For the pattern fashion dataset, it consists fashion images categorize into 5 different patterns: flora, graphic, plaid, solid, strip. Each neckline category has around 700 images

Proposed Scheme

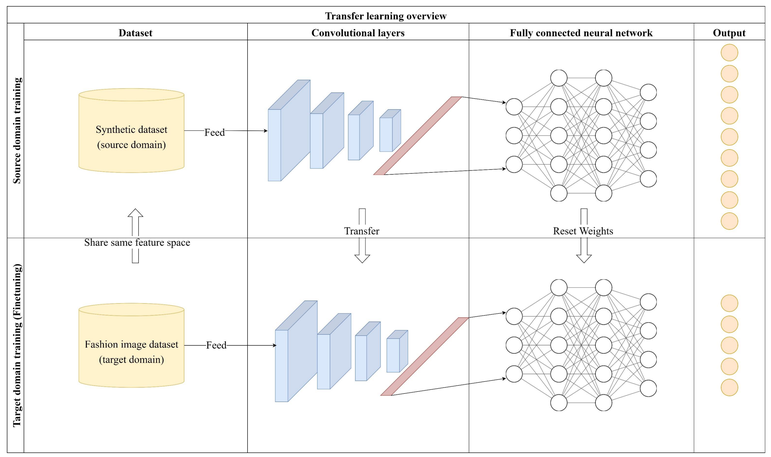

Fig.2 Overview of our proposed scheme

Our proposed scheme consists of 3 main stages. In stage 1, we analyze and process the datasets of target domain, then we create the datasets of source domain based on the visual features of the target domain. With the datasets prepared from stage 1, we can start process of the transfer learning framework in stage 2 and 3.
For both classification tasks, We divide the neckline into 5 categories: round, square, strapless, v neck, and one side shoulder, and divided the clothing pattern into 5 categories: flora, graphic, plaid, solid, and striped. We then label the fashion images by hand based on the classes. We then classify our collected fashion images based on our decided classification classes by hand.

1. data preparation
   1.1 segment the neckline dataset with SegNet
   1.2 crop the segmented dataset
   1.3 create 2 synthetic datasets (1 for neckline classification, 1 for pattern classification)
2. train source domain (pretraining)
   train models(Resnet, VGG19) with synthetic datasets until convergence
3. train target domain
   3.1 modify the models(Resnet, VGG19): freeze the convolutional layers, reset fully connected neural network weights, change the output number from 9 to 5
   3.2 train models(Resnet, VGG19) with fashion image datasets (5-fold cross validation)
4. compare the performance(accuracy, training time) with models without transfer learning
   4.1 neckline classification: transfer learning vs no transfer learning
   4.2 pattern classification: transfer learning vs no transfer learning

Results

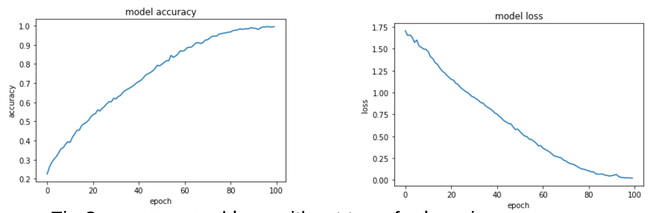

Fig.3 accuracy and loss without transfer learning

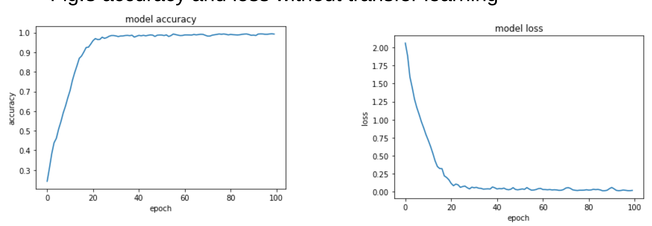

Fig.4 accuracy and loss in our scheme

From the Fig. 3 and Fig4, we can see that the deep learning models in our schemes reach the convergence faster than the deep learning models without transfer learning.

Conclusions

Our project proposed a transfer learning scheme that improves the performance of fashion apparel classification, specifically neckline and pattern classification, with small size datasets. Our approach leverages the synthetic datasets generated based on the visual features of the fashion images. Our experimental results shows that deep learning models in our transfer learning scheme reach higher accuracy. Also, deep learning models in our proposed scheme reach convergence faster while training with the target domain datasets.
Our synthetic datasets and fashion image datasets share visual feature space and deep learning models could learnt from the synthetic datasets and improve the performance while learning from the target domain datasets. In the neckline classification

Acknowledgments

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References

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