College of Engineering

COMP 437/537 – Intelligent User Interfaces

Project Proposal

Fashion Compatible and Personalized Wardrobe Outfit Recommender App (Modisto)

Spring 2023

Student Information: Beyza Çavuşoğlu 000084999 bcavusoglu23@ku.edu.tr

Github Link: https://github.com/BeyzaCavusoglu/Fashion-Compatible-and-Personalized-Wardrobe-Outfit-Recommender-Modisto.git

Abstract

Fashion is perceived as a meaningful and strong way of self-expressing that people use for different purposes. Well-chosen fashion compatible clothes may have signification positive effects on personal life. For that purpose, Fashion Recommendation Systems (FRS) are widely preferred. FRS can be defined as a means of feature matching between fashion products and users under specific matching criteria. However, one-sidedness is a problem in FRS that hasn't been dealt with in detail by the previous work. They can be categorized as being only based on personalized outfit recommendations but not fashionable, only based on events or only based on fashion compatibility, not user preference. The novelty of the Modisto app comes from combining all these important features and producing a high-quality, fashionable, event-based and personalized outfit recommendation app based on the images taken from the user's wardrobe. Moreover, Modist also provides an item buying recommendation by finding similar clothes from datasets to overcome the issue of the user having a small number of items in the wardrobe for the start.

TABLE OF CONTENTS

Section 1 Introduction

1.1 Concept

Clothing is a type of symbol that utilizes people's outer appearance to It conveys information about their internal perceptions such as their choices, faith, personality, profession, social status, and mood. Therefore, clothing is believed to be a major part of daily nonverbal communication exchanged by individuals [11]. Due to that reason, Fashion Recommendation Systems play an important role in the digital application industry. However, the previously done works related to FRS are not complete due to several reasons such as recommending only a single clothing item instead of an outfit, only being based on either personalization or caring about being fashionable.

In this paper, a novel FRS is proposed. By user's wardrobe images, Modisto recommends personalized, well-matched outfits. Pre-trained models are utilized as the starting point for the image recognition phase which is called Transfer Learning. A CNN (deep neural network) is used with a feature extractor. After applying some filters based on color, occasion, and season; the outfit recommendation is given as the output of the application. If the user has not had enough items to match a good outfit, then the app provides similar clothes that would complete the missing part of the outfit.

1.2 Objectives

The goal of this project is to help users to organize their closets by getting fashionable outfit suggestions. By utilizing the camera of the laptop, images are uploaded to the system. After applying several techniques, personalized high-quality outfits and similar buying options will be provided to the user.

1.3 Background

Figure 1 represents the flow diagram of Modisto's methodology. Initially, the user opens the Modisto app and uploads images of wardrobe items. The images are then preprocessed and feature extraction is done using a pre-trained model. Convolutional Neural Network (CNN) is a deep learning algorithm that can take the image, label importance by learnable weights and biases to several objects in the image and be able to differentiate one from the other by classifying. Residual Networks (ResNet) and Inception have been central to the biggest developments in image recognition performance in recent years, with very good performance at a relatively low

computational cost. ResNet is a CNN architecture that made it possible to construct networks with up to thousands of convolutional layers, which outperform shallower networks. Inception-ResNet combines the Inception architecture, with residual connections. Inception-ResNet-v2 is also a CNN that is trained on more than a million images from the ImageNet database. For that reason, this is achieved by the Faster RCNN model using the Inception Resnet v2 feature extractor. According to the result obtained, if the model accuracy is not as high as desired, Yolov5 can be used.

After classification is done, the outfits can be generated and recommended to users. Outfit recommendations will be also given according to the filters such as color fashion compatibility, weather conditions due to the season and user preferences. Personalized outfit recommendation is achieved through an ontology-based recommendation system that provides fashion advice and user style preferences. For this purpose, PServer which is an open-source multi-purpose personalization engine is used [3].

Furthermore, a user may not have enough items to generate well-organized outfits, to overcome this issue, items to buy recommendation is also generated. At the final stage, users can rate the recommended outfits which will produce feedback and data for personalization.
For this project, several datasets are utilized such as Polyvore, DeepFashion (which contains over 800,000 fashion images) and finally Fashionista Dataset (158,235 images, unannotated, cloth recognition).

Finally, the accuracy of the model can be determined by using evaluation metrics such as mAP. For this reason, the threshold is determined by Intersection Over Union (IOU) which scores the detected object. By using thresholds and creating a precision recall curve, AP (average precision) and mAP (mean average precision) will be calculated.

Section 2 S/T methodology and associated work plan

2.1 Methodology

Figure 1 represents the flow diagram of Modisto's methodology. Initially, the user opens Modisto app and uploads images of wardrobe items. The images are then preprocessed and feauture extraction is done using pretrained model. Convolutional Neural Network (CNN) is a deep learning algorithm that can take image, label importance by learnable weights and biases to several objects in the image and be able to differentiate one from the other by classifying. Residual Network (ResNet) and Inception have been central to the biggest developments in image recognition performance in recent years, with very good performance at a relatively low computational cost. ResNet is a CNN architecture that made it possible to construct networks with up to thousands of convolutional layers, which outperform shallower networks. Inception-ResNet combines the Inception architecture, with residual connections. Inception-ResNet-v2 is also a CNN that is trained on more than a million images from the ImageNet database. For that reason, this is achieved by Faster RCNN model using Inception Resnet v2 feature extractor. According to the result obtained, if the model accuracy is not as high as desired, Yolov5 can be used.

After classification is done, the outfits can be generated and recommended to users. Outfit recommendations will be also given according to the filters such as color fashion compatibility, weather conditions due to the season and user preferences. Personalized outfit recommendation is achieved through ontology-based recommendation system that provides fashion advice and user style preferences. For this purpose, PServer which is an opensource multi-purpose personalization engine is used [3].

Furthermore, a user may not have enough number of items to generate well-organized outfits, to overcome this issue, items to buy recommendation is also generated. At the final stage, user can rate the recommended outfits which will produce a feedback and data for personalization.

For this project, several datasets are utilized such as Polyvore, DeepFashion (contains over 800,000 fashion images) and finally Fashionista Dataset (158,235 images, unannotated, cloth recognition).

Finally, accuracy of the model can be determined by using evaluation metrics such as mAP. For this reason, threshold is determined by Intersection Over Union (IOU) that scores the detected object. By using thresholds and creating precision recall curve, AP (average precision) and mAP (mean average precision) will be calculated.

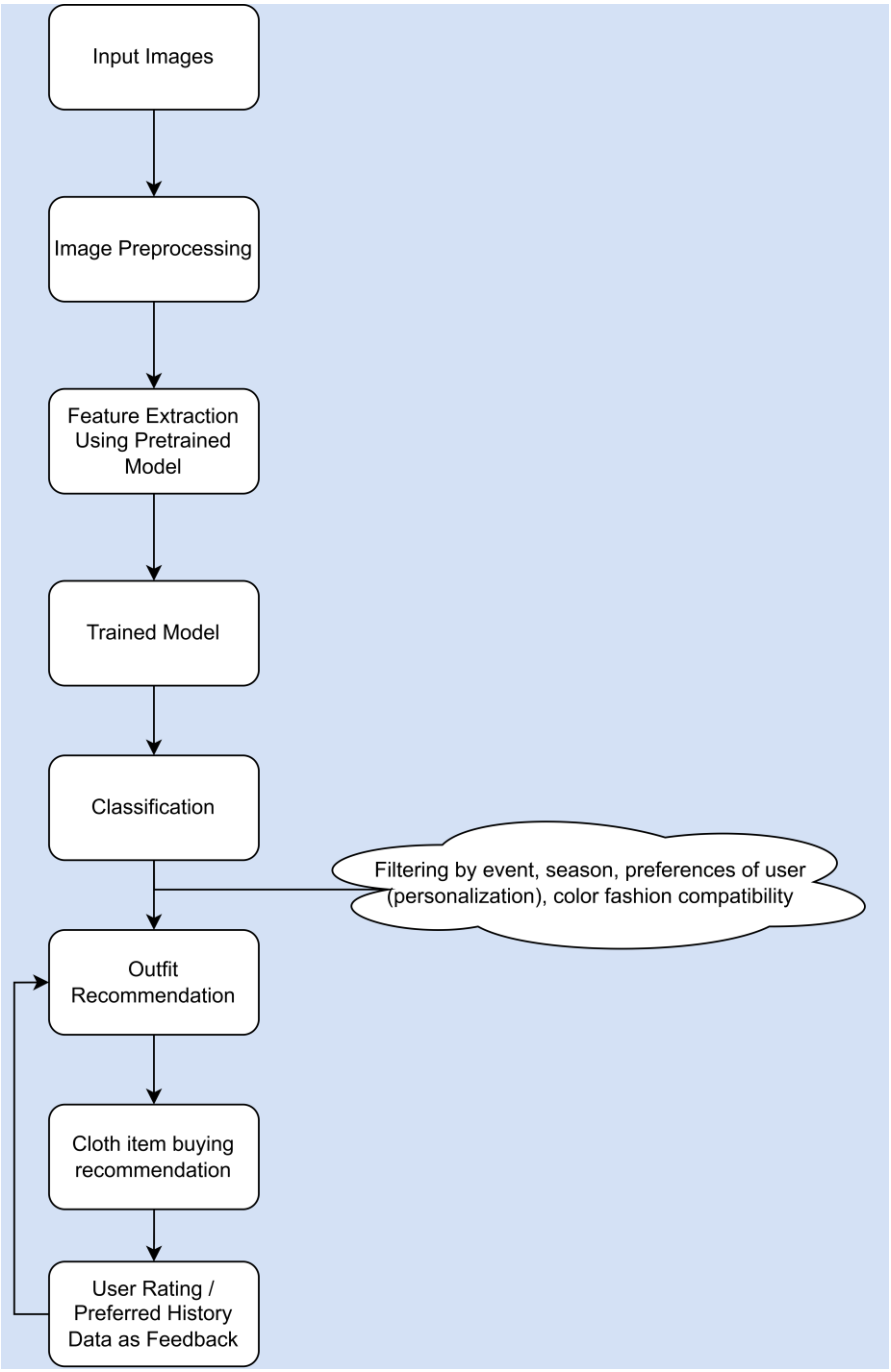


Figure 1. Methodology of Modisto in step-by-step explanation

2.2 Work Package Descriptions

Please write down your execution plan in detail according to following table. Your execution plan will be divided to 2-day units.

Days	Deliverable	Detailed Description
2	3 different clothing datasets	Obtaining and preparing three different datasets. Collecting color, event and cloth data.
4	Organized one big database	Organizing and cleaning data to be useful in model, create one useful database.
8	Faster RCNN model	Training faster-RCNN model with Inception Resnet v2
16	Outfit Recommendation	Filtering based on user preferences, season and color, then combining garments to create outfit
24	Application interface design	Designing an application interface
26	Basic Application	Building and testing the application
30	Final Product	Integrating model to the application
34	Performance measurement	Evaluating performance and the accuracy of model
36	Questionnaire	Preparing questionnaire to selected group of users, conduncting experiments with them
40	Project Final Report	Writing project final report

2.3 Demonstration

The performance measure of the model will be calculated using mean average precision (mAP). The quality of the app will be determined after the interaction of the app with many users and getting feedback from them about the recommendations's performance and the app usability. A group of users will be selected for the first test of the final product and they will be asked to perform an evalution on the application design, easy understandability of the usage, the recommendation success and their overall opinions about the application. Modisto will be improved accordingly.

2.4 Impact

People may have limited time to organize the clothes in their wardrobe, they may have lack of information about fashion. Modisto can help them creating high-quality fashionable outfits by saving time giving helpful recommendations. The app can also help the users to save money because it created several different outfits with the limited number of items in the closet.

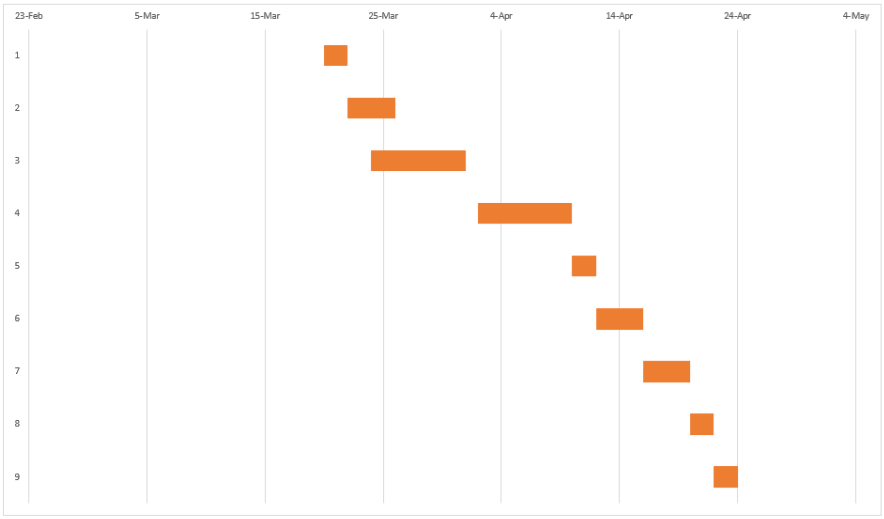
2.5 Risk analysis

There are two main concerns Modisto may have in risk analysis. First challenge can be having a great model accuracy. The model may fail to recognize some clothes from images taken by user if they are not pictured in a right way. This risk can be eliminated by giving some instructions to user for taking photos appropriately. The second one is time and power consumption may be too much to overcome due to the high amount of data around 1 million images. This issue can be solved by cleaning the dataset before model training.

2.6 Gantt Chart

Fashion Compatible and Personalized Wardrobe Outfit Recommender App

MODISTO			DURATION (days)
START DATE	END DATE	DESCRIPTION	
3.20.23	3.22.23	Obtaining and preparing three different datasets. Collecting color, event and cloth data.	2
3.22.23	3.26.23	Organizing and cleaning data to be useful in model, create one useful database.	4
3.24.23	4.2.23	Training faster-RCNN model with Inception Resnet v2	8
4.2.23	4.10.23	Filtering based on user preferences, season and color, then combining garments to create outfit	8
4.10.23	4.12.23	Designing an application interface	2
4.12.23	4.16.23	Building and testing the application	4
4.16.23	4.20.23	Integrating model to the application	4
4.20.23	4.22.23	Evaluating performance and the accuracy of model	2
4.22.23	4.24.23	Preparing questionnaire to selected group of users, conducting experiments with them	2



Section 3 Economical and Ethical Issues

Modisto application does not need to be funded right now, it utilizes the open-source datasets and tools. And because it uses the open-source datasets and get information from well-prepared academical research papers through referencing them, there is also not any ethical issue.

Section 4 References

1) Ramesh, N., "Outfit Recommender System" (2018), Master's Projects, 611.
DOI: https://doi.org/10.31979/etd.8c8x-txe7

2)Nair S., Patil K., Waghela H., Pansambal S., “Outfit Recommendation – Using Image Processing”, Journal of Algebraic Statistics, Volume 13, No.2, 2022, p. 1699-1706, ISSN: 1309-3452.

3) Kaur G., Malhotra H., Gupta T., “Choosing the Right Model: A Comprehensive Analysis of Outfit Recommendation Systems”, International Journal of Computer Applications, Volume 183 - No.12, June 2021.

4) Sha, D., Wang D., Zhou X., Feng S, Zhang Y, Yu G.., “An Approach for Clothing Recommendation Based on Multiple Image Attributes”, June 2016, DOI: 10.1007/978-3-319-39937-9_21.

5) Stylebook app, https://www.stylebookapp.com/

6) Pureple app, https://pureple.com/

7) Huang Y., Huang T., “Outfit Recommendation System Based on Deep Learning”, Advances in Computer Science Research, volume 74, 2nd International Conference on Computer Engineering, Information Science & Application Technology (ICCIA 2017).

8) Reyes L., Oviedo N., Camacho E., Calderon J.,“Adaptable Recommendation System for outfit Selection with Deep Learning Approach”, IFAC PapersOnLine 54-13 (2021) 605–610.

9) Lu Z., Hu Y., Chen Y., Zeng B., “Personalized Outfit Recommendation with Learnable Anchors”, CVPR 2021.

10) Cladwell app, https://cladwell.com/app

11) Barnard, M. “Fashion as Communication”, 2nd ed.; Routledge: London, UK, 2008.

12) Sarkar R., Bodla N., Vasileva M., Lin Y., Beniwal A., Lu A., Medioni G., “OutfitTransformer: Outfit Representations for Fashion Recommendation”. CVPR.