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Fashion Recommender System (FRS): Image Based Engine for Personalized Outfit

H. Sarojadevi[1], Vineet Bhat[2], Rohan Palekar[3] and K. Neha[4]
[1]Professor, [2,3&4]Student,
Department of CSE, Nitte Meenakshi Institute of Technology, Bengaluru, Karnataka, India
E-mail: sarojadevi.n@nmit.ac.in, vineetbhat00@gmail.com, rohanspalekar9401@gmail.com, nehak.reddy13@gmail.com
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***Abstract* - The methods used to predict how highly a person will evaluate a product or a group of people are known as recommendation systems. Books, movies, restaurants, and other products can be among the things commonly recommended. Objects where people differ in their preferences matter a lot. For predicting the preferences 2 methods are used, one a content based approach that considers the characteristic of an item, and the other is a collaborative method that evaluates choices by taking into account previous user behaviour. In this paper, a system for recommending fashion items is proposed, one that will base its recommendations on the provided clothing images' styles. The upper body and lower body clothing images, as well as those of a human model, are the main focus of this work. We have used the fashion image dataset from Kaggle website. This paper presents an idea to develop a content based recommendation system that uses convolutional neural network model, ResNet-50.**
***Keywords*: Web App, Web Scraping, Recommendation System, Content-Based Filtering, Vue.js, Flask, ResNet-50**

I. INTRODUCTION

A comprehensive set of web applications known as a recommendation programme includes user responses. The subject of recommendations has long been popular. Recommendation Techniques, also known as recommendation programmes, are straightforward algorithms that seek to give the user the most pertinent and accurate information possible by selecting useful items from a sizable pool of information resources. By analysing consumer preferences and producing results that are relevant to their needs and interests, recommendation engines are able to identify data patterns in the data set. A recommendation engine has been used in real-world examples like Amazon, Myntra, Flipkart to suggest products that customers might like.

During the recent era, recommender systems have become increasingly prevalent in our lives because of the growth of websites like Amazon, Netflix, YouTube and many others. Recommender systems are a necessary part of our daily online activities, be it e-commerce (giving suggestions to buyers' articles that may interest them) or online advertising (recommend to users about the right contents, that match their preferences). When designing such systems, content based filtering is a commonly used method.

Description of the items and user's preference based profile are key factors in content based filtering approaches. These techniques perform the best in scenarios where an object possesses known information (name, description, location, etc.), however not the user. Content based recommendation systems by themselves learn a user's preferences depending on the characteristics of a particular item and consider recommendation as a specific user problem. The algorithms strive to suggest products that are comparable to the user's current or past preferences. It creates this temporary profile without using a user login device. Particularly, a number of candidate items are contrasted with items that have received high user ratings. Research on data filtering and information retrieval forms the foundation of this strategy.

The aim of this work presented here is to create a model that can make fashion recommendations [8] just by looking at its image. When a model accepts an image, it first assesses whether or not it features a fashion item before making a recommendation.

The primary objectives of the work carried out are as follows.

1. To create an innovative fashion style recommendation system that provides answers to questions about shopping for clothing.
2. To determine the fashion category of the given input image.
3. To suggest an ensemble of clothing depending on whether the fashion image provided is accurate.
4. To get products from various e-commerce websites that were found through similar search terms.

The rest of the paper is organized as follows. Section II describes related work. Section III provides design overview. Section IV presents implementation details. Section V is about the results and the analysis. Section VI presents the conclusion.

II. REVIEW OF LITERATURE

A few of the research works related to the fashion recommender systems are discussed in this section.

Another fashion recommendation system that is deep learning based one with Style Feature Decomposition is presented in [2]. In this the vector for clothes often suggests mismatched clothing because of the use of mixed form of information of style & category. Here a Style Feature extraction (SFE) layer is proposed to address and solve this issue of mismatching by way of decomposing the given clothing-vector into style and another as category. Then category information is extracted and removed from the clothing vector for obtaining improved precise style information. Depending on the perceived characteristics, the category information has minor variations within the same given class while getting distinguished from the other classes.

Deep learning based feature extraction using CNN along with Extreme Learning Machine (ELM) are experimented by researcher in [3]. VGGNet and ResNet models are implemented and it is found that the ResNet model is a promising approach for the fashion classification problem. A CNN based model is researched in [5], with different classes CNN architecture patterns are arrived at to meet the users' as well as designers' preferences online.

A content based deep neural network model is analysed for online recommendation of fashion items in [6]. Gender feature is also included in this. Compared to the other equivalent systems loss values are less in this system. In [7] clothing prediction & classification system is developed with MLP, CNN & extreme learning machines and the data used is Fashion MNIST and the implementation results were with impressive accuracy.

Three different models are experimented in [4] and a new contour extraction method for improving the effectiveness of the processing of fashion information is developed. Trade-off between accuracy, efficiency & effectiveness is still an open issue as per this reference.

III. DESIGN

A. Proposed Architecture Components

The proposed recommender system comprises the following component parts.

1. Image preprocessing
2. Recommendation Engine
3. Web Scraping
4. Web App

B. Proposed System Description

A description of the proposed system with its component parts is given below.

1. Image Pre-Processing: Image processing is known to be the process of working on digital images using various algorithms. The main objective is to enhance the image pixels and further refine the image data by the process of noise removal. A two-dimensional array of numbers between 0 and 255 forms an image. An image is represented a mathematical function f(x,y), where x and y denote the two coordinates , horizontal and vertical axes, respectively. The pixel value of an image is represented by the value of f(x,y) at that location.

The steps involved in the pre-processing of the image are as follows.

a. Read Image: The user's image is used as input and saved temporarily in a folder on the server.

b. Resize Image: After being saved in a temporary folder on the server, the user's image is resized to match the input size that the model has been trained with, which is 224 x 224. This involves reading the image, resizing it, and then storing it back in the temporary folder on the server.

c. Segmentation: To enable more effective feature extraction, the saved image is changed from RGB to BGV at this stage.

d. Flatten: Following the pre-processing, the image's 2D matrix is transformed into a vector in this stage.

2. Recommendation Engine: A recommendation engine categories through data using various algorithms and suggests to users the items that are of interest to them. It first records a customer's prior behaviour before making recommendations for goods they might be inclined to purchase. The recommendation engine functions as follows:

a. Data Collection: The first step in developing the recommendation engine is data collection. There are two types of data: explicit and implicit. Users' feedback on products, such as reviews and comments, can be considered explicit data. Additionally, implicit data such as clickthrough and search log, cart events, order history/return history, and page views would be included. Each time a user accesses the website, a dataset is generated.

b. Analyzing the Data: Realtime system analysis is used to filter data. Data can be processed in real-time as it is being created. Tools that can process and analyse streams of events are typically used in this system. It is necessary to make recommendations right away.

3. Web Scrapping: Web scraping is the quick and effective automation of the data extraction process. It makes use of robots or crawlers that automatically scan particular website pages and extract the necessary data. We implement a piece of code (referred to as a "web scraper") that makes a specific product page request on an e-commerce website in order to extract product data on a large scale. The website responds with the web page that was requested. After

receiving the page, the scraper will parse its HTML code and extract the necessary information. The tool finally converts the data into the required format after the data extraction process is finished. Due to its automated nature, the web scraper can execute this process multiple times on a vast amount of product pages, and across numerous e-commerce websites.

4. Web App Front End Design: The web app's interactive interface is developed using the Vue.js framework. Meanwhile, the Flask framework is utilized to design the back end of the web app, specifically to create a RESTful API.

IV. IMPLEMENTATION

Implementation involves developing a front end and then providing algorithmic implementation, feature extraction, classification and the analysis using the deep learning architecture RESNET**.**

A. Features Extraction

Feature extraction is the procedure of converting raw data into numerical features that can be analysed while preserving the relevant information from the original dataset. Using machine learning on extracted features is more effective than using it on raw data directly, resulting in superior outcomes. Fig. 1 shows this process.

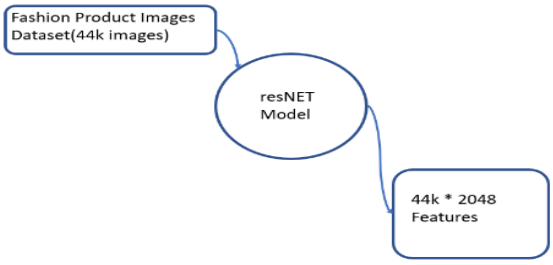

Fig. 1 Feature Extraction

The Fashion Dataset which consists of 44 thousand images are used by the resNET model. For each image in the Dataset, this model has output 2048 features. A pkl file will contain these features as embeddings. We have imported resNet50 model from TensorFlow library. Weight used for the same is ImageNet training dataset. We remove the top layer of the resNet50 and add our own layer. We add the globalMaxPooling 2D as a top layer for this sequential model.

Images are loaded as PIL (Python Imaging Library) library object file. Every single image is converted to NumPy array. Dimensions are expanded as Keras works with batch of images. And it expects images to be in a batch even if it is a single image.

Preprocess_input() function from TensorFlow converts image array from RGB to BGR and then each color channel is zero centered with respect to the ImageNet dataset without scaling. As now the pre-processed input is ready it has to flattened to make it 2D as it is 2048 dimensional. The data next is normalized using the L2 norm and returned. These normalized embedding are stored in PKL file. For the input image for which we have to recommend products, the same procedure is repeated, and it is then compared with the embeddings generated from dataset. For comparison Nearest neighbours algorithm is used. The metric of distance used is Euclidean. So finally, we will get recommended product's images from the dataset.

V. RESULTS OF THE STUDY

Users of this web app can locate products using images. By clicking an image of the product and uploading it to the Web App, it offers a simple interface that helps the user find a product that they may find visually appealing. Products that the model determined to be similar to the uploaded image will be shown to the user. A few of the test cases in this study are presented in the subsequent portion here.

Fig. 2 shows that when the user provides an image of the Indian cricket team jersey as input, the recommendation engine generates a list of five jerseys that are similar to the input image as a recommendation and it is a proper output.

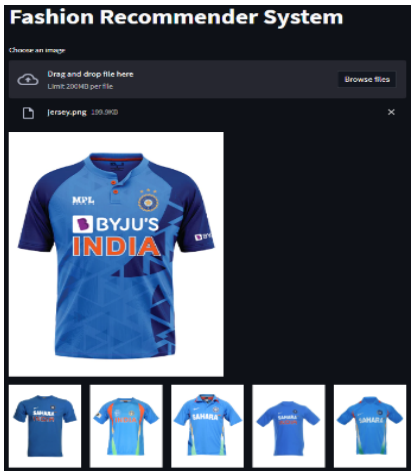

Fig. 2 Example

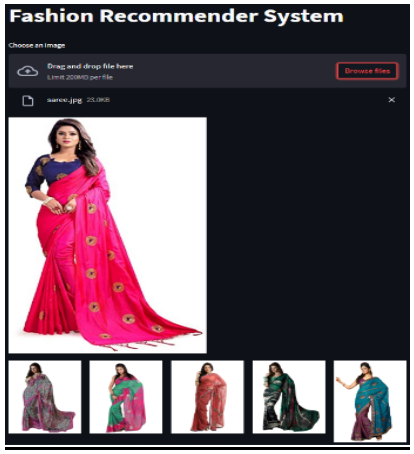

Fig. 3 User's choice

In Fig. 3 the user provides a picture of saree as input and the recommendation system generates five similar sarees, which matches the user requirement specifications.

Fig. 4 Inaccurate Result example

Fig. 2 and Fig. 3 show the recommendation based on the user input accurately. Whereas Fig. 4 is showing inaccurate results because it fails to recommend products based on gender. This establishes that there is still scope for improvement in the fashion recommender system.

VI. CONCLUSION

Engines that make product recommendations are the best at giving customers a better user experience. A product recommendations engine can assist in bringing customers the pertinent products they want or need through machine learning, manual curation, and particular algorithms. It enables marketers to instantly offer customers pertinent product recommendations. Product recommendations are used as part of an e-commerce personalization strategy to dynamically add products to websites, apps, call centres, or emails, improving the user experience. Product recommendation engines can now support even the largest of product catalogues thanks to specialised algorithms. In any given circumstance, for any given individual shopper, the engine is capable of making an intelligent decision regarding which algorithms and filters to use. Accordingly, marketers can raise conversion rates and average order values.

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