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Outfit Recommendation – Using Image Processing

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ABSTRACT
Recommendation systems are strategies for predicting an individual's evaluation of an item or social institution. Books, movies, restaurants, and other products on which people have differing opinions can be included. On e-commerce platforms with many options, an effective recommendation system is needed to sort, order, and efficiently communicate relevant product material or information to users. FRS's (image-based fashion recommendation systems) have gotten a lot of interest from fast fashion retailers since they give customers a more personalised buying experience. When going out in the real world, it is critical to dress appropriately. Wearing clothes that have some amount of flair and that comply to societal standards boosts a person's confidence and makes a favourable impression. In this paper we have proposed a fashion recommendation system which will revolutionize the e-commerce industry. This proposed system will make it more accessible to the user the type of outfit the individual is looking for by just uploading an image similar to which the individual wants recommendation for.

Keywords - Application of CNN Algorithm, Image Processing Application, Content-Based Filtering for Recommendation System, Feature Extraction using CNN Algorithm, Outfit Recommendation System, E-commerce, Machine Learning Application.

1. INTRODUCTION

Recommender systems such as Youtube, Amazon, Netflix, and many other similar web services have become increasingly important in our lives over the previous few decades. From e-commerce (suggesting to buyers that they buy articles that may be of interest to them) to online advertising (suggesting to users the proper material that matches their tastes), recommendation systems are becoming an unavoidable part of our everyday online lives. In the most common sense, recommendation programmes are algorithms that propose items that are related to
the user's interests (such as watching movies, text to read, products to buy and anything else depending on industry). Recommendation systems are quite important in some industries since they earn a big amount of revenue when they are efficient and also provide a significant opportunity to stand out.

2. LITERATURE SURVEY

Shinya M et.al. [1] The paper proposed a retrieval technique for fashion-related images on websites. It's quite difficult to find images of people wearing clothing from images of clothing. This is due to the wide range of differences between clothing images) and those in the fashion coordinate images). Conventional image retrieval methods are inapplicable in this case. As a result, we separate fashion imagery from other critical factors. The full-body fashion coordinate image is divided into four areas, and an image is returned that includes a similar clothing image to the query in the target area.

This programme assists in the portrayal of numerous styles based on fashion integration and picture recognition abilities. To construct a knowledge-based fashion integration tool, this method uses image detection technology to extract fashion designs with similar elements and incorporates both visual and written information. It can recommend a design plan using genetic algorithms (GA) and artificial neural networks as a search approach. Congying Guan., & Shengfeng Qin [2] came up with a clever or astute suggestion for the International Journal

of Clothing Science and Technology. Its domain expertise knowledge of mixing and matting criteria facilitates exploring the interrelationship between fashion and the user through the usage of intelligent algorithms. To learn the talent of clothing attribute evaluation, they employed decision trees, analytical hierarchy process, sensory engineering, fuzzy math, genetic algorithms, neural networks, and support vector machines. Application of interactive evolutionary algorithms and the implementation of expert rules to construct an intelligent fashion suggestion system based on eye gaze monitoring and the prediction of users' style preferences.

Jun Xiang et al. [3] In this, the recommendations are based on previous sales, clothing purchase data, eye movement records, and item click rate. It delivers outfit ideas based on the user's preferences and interests, utilizing an analytical hierarchy method. The CNN Algorithm can be used in conjunction with feature extraction and image classification to aid in the retrieval of comparable picture products.

Sebastian Heinz et al. [4] discovered that buyers are more likely to buy uncommon things, but they also tend to buy more items at once. They presented the results of a backtest using data from 100k frequent customers at Zalando, Europe's top fashion forum. Their suggestion employs a pair of neural networks to solve the initial cold start issue. The feedforward network starts article embedding in the "fashion region," which is then fed into a recurrent neural network, which predicts a fashion vector for each client based solely on their previous purchase history. The output is compared to the static collaborative filtering approach and the popularity ranking baseline.

Heinz et al. [5] employed a dynamic collaborative filtering technique to construct a recommendation system using RNN (Recurrent Neural Network). From a single purchase price to a series of sales events, the RNN-based recommendation system analyses individual style preferences. The proposed Recurrent Neural Network model had a greater Area under the Curve value of 88.5 percent than a popularity ranking baseline approach, which had an Area under the Curve value of 80.2 percent.

Guan, et al. [6] developed a content-based filtering algorithm using CNN (Convolutional Neural Network). Using image features, the recommendation algorithm produced weather-related outfit pairing recommendations. On the Normalized Discounted Cumulative Gain (NDCG) ranking scale, the proposed Convolution Neural Network model received a maximum score of 0.50, exceeding the support vector machine (SVM), which received a score of 0.45.

Leininger et al. [7] The research proposes a retail recommendation system using kNN and collaborative filtering approaches. Distance is calculated using cosine similarity between related things, then individual products are clustered. The accuracy in terms of AUC (91 percent) was higher than the baseline model's AUC (85 percent).

The most effective way to increase sales for a company is to provide recommendations to its user. The paper showcased both the collaborative filtering as the base model and an ensemble model as a novel approach. In the AUC metric the novel ensemble model slightly outperformed the collaborative filtering model. The outperformance might be because of the computational power of the neutral network and the complexity of different individual models. Even though novel approach model performed better but it consumed significantly more time to run. Thus, collaborative filtering is more economical approach for the problem stated in the paper. The preformed of the model could have been improved if additional data such as customer transaction and data features would have been introduced. J. Hilburn continues, real world testing should be kept in focus keeping constant improvement of the model as the primary target by adding additional data fields.

Yu-Chu et al. [8] The paper proposed an approach that used Bayesian network for recommending personalized clothing which used collaborative filtering approach. The USP of the model was that it recommended clothes based on the user’s preferences rather than other user’s shopping practices. 90% was the recommendation accuracy and the model’s overall accuracy was 50% more than the basic Bayesian model’s accuracy.

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Kang et al. [9] The research developed a personalised clothes recommendation system using collaborative filtering techniques and GAN. The model learned and suggested clothes to the user based on fashion photographs, which maximized the user's tastes. In terms of preference score, the model outperformed a retrieval-based strategy by 6.8% and outperformed the Bayesian Personalized Ranking model by a significant 5.13 percent.

3. Table: Summary of Literature Survey

Sr. No.	Authors	Method	Advantage	Disadvantage
1.	Miura, Yamasaki, Aizawa	**Fashion Pairing Recommendation System** –Image detection technology is used to extract fashion styles with similar features.	**1.** Assists users in determining what kind of coordinates are appropriate for their clothing and in purchasing appropriate items.	**1.** It can't handle a change in a person's pose or figure.
2.	Congying Guan, Shengfeng Qin	**Smart or intelligent recommendation** – It's domain expertise knowledge of stirring and corresponding criteria enables intelligent algorithms to explore the inter-relationship between fashion and the user.	**1.** Produces highly accurate predictions on apparel.	NA
3.	Jun Xiang	**Fashion Image Retrieval –** CNN can be used in conjunction with RNN for feature extraction and image classification, which aids in the retrieval of similar image products.	**1.** A fashion sketch contains more information than a text. **2.** Sketch is a simple way to express fashion image styles without ambiguity.	NA
4.	Heinz	**RNN Recommendation System** - RNN was used to create a recommendation system that used the dynamic collaborative filtering technique. The RNN-based recommendation system recognized individual style preferences from a limited number of purchases by aggregating sales events.	1. RNN can handle any length of input. 2. In any time series predictor, an RNN model is designed to store each bit of info throughout time, which is incredibly valuable. 3. The model size stays unchanged regardless of the input size**.**	1. Because of its recurrence, the computation is slow. 2. Training RNN models can be challenging.

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5.	Guan and Liu	Used **CNN** to develop content-based filtering technique.	**1.** Image recognition problems require a high level of accuracy. **2.** Without any human intervention, it automatically detects the important features.	**1.** Lots of training data is required. **2.** A large amount of training data is required.
6.	Leininger	The **KNN** model calculated the distance to similar items using cosine similarity, accompanied by individual product clustering.	**1.** The algorithm is simple to comprehend and implement. **2.** It is able to quickly adapt to new training data.	**1.** The speed at which Calculations are performed rapidly decreases as your training data grows. **2.** If the model is not correctly chosen, it will be underfitted or overfitted to the data.
7.	Yu-Chu	Using content-based filtering techniques, a Bayesian network was used to construct a personalised clothing-recommendation system.	**1.**Can handle incomplete datasets.	**1.** The number of network architectures that can exist grows in direct proportion to the number of nodes.
8.	McAuley, Kang, Fang and Wang	**1.** GAN - to create a personalized Recommendation system through the use of collective filtering methods. **2.** These models studied the distribution of fashion photographs and created novel fashion items that catered to users' preferences.	1. It produces data that resembles the original data. 2. GANs get into specifics data and can quickly translate into multiple languages as a result, it is beneficial when working with machines work learning	**1.** More difficult to train: You must continuously submit different sorts of data to see if it works correctly. **2.** It is quite difficult to generate outcomes from text or speech.

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4. PROPOSED SYSTEM:

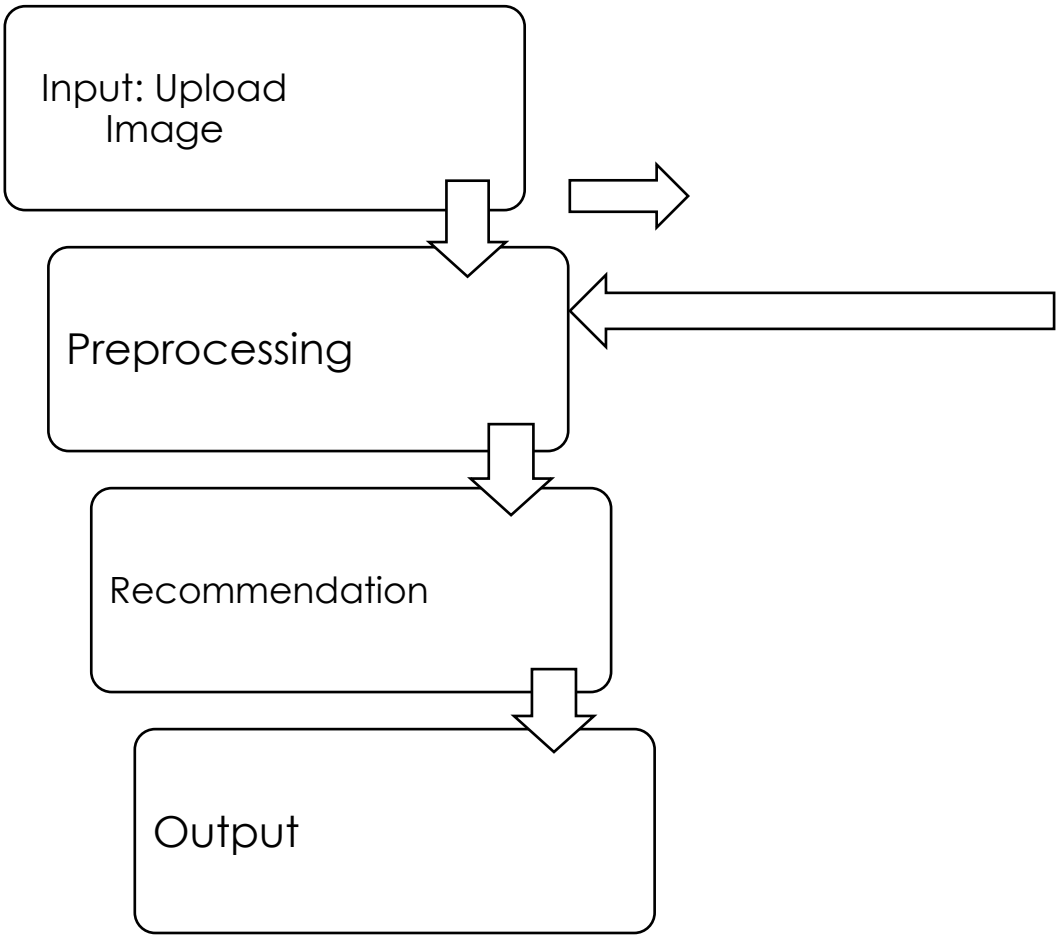

Fig. BLOCK DIAGRAM

4.1 EXPLANATION:

Initially the user opens the WebApp and uploads an image of the outfit for which he desires to find a matching outfit. The image is then preprocessed using a number of algorithms like the CNN algorithm. The CNN algorithm will first resize the image to a standard 128 x 128 size and then the image will be segmented. In segmentation, the image will be then converted from RGB to BGV which will aid in better extraction of features. The segmented image will be then flattened. In this, the image's 2D matrix will be converted into vector. The vector will be useful in finding similar images.

The next step is finding similar images which will be relayed as the output. In this step the vector of the input image will be used as a standard vector which will be used to compare with the vectors of the images from the dataset. The last step of the model is to display similar images from the dataset with shopping links.

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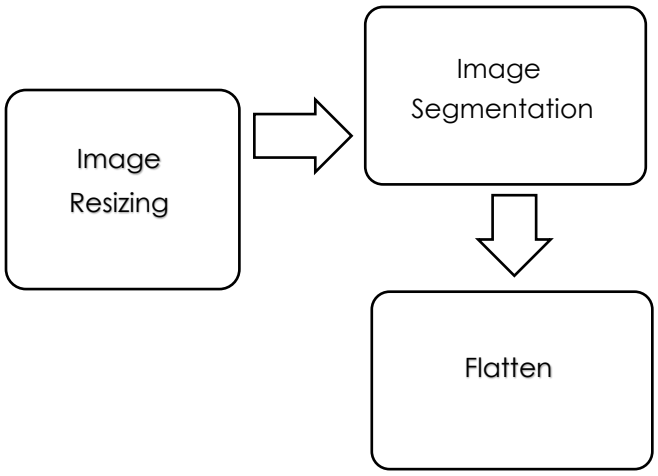

5. METHODOLOGY

The rationale for choosing the Agile method is its efficiency, which allows for faster expansion without a lot of documentation. In the case of an Android application, we must constantly build, check, correct, rebuild, and test, and we must repeat these steps every time we make changes to ensure that the results of our work are correct. Agile approaches, which include programming, development, and project management, simplify software development by breaking it down into small modules and incorporating documentation and quality testing at each stage. The traditional waterfall methodology involves determining needs ahead of time and treating testing and documentation as an afterthought rather than an essential element of development. This approach outlines techniques for improving portable apps that are both effective and profitable.

Agile is quite well suited to rapid website delivery and a shorter development lifecycle:

Whereas the team should remain committed to delivering an agreed-upon subset of the product's features throughout each cycle, the total product backlog can be constantly refined and reprioritized. Agile supports the bug-free, quick delivery of items all over. Trying is coordinated throughout the lifecycle of spry development, allowing for continuous exploration of the functioning piece as it develops. This allows the item owner to make necessary changes and offers the product group early notice of any quality problems.

The following primary modules make up the application:

1) Input module:
    - This input module has the functionality to take input image from the user, which will be further processed to give user the desired output.
2) API module:
    - The API module is dependent on the input module. It will require input image to process the API request which will consequently give an output image.
    - This image will be sent to the machine learning model using the API and the output will be transported to the WebApp also via the API.
3) ML module:
    - The ML module is dependent on the API module. Once the API module provides the ml model with the input image the magic of finding similar outfits begin.
    - The ML model will use CNN algorithm to process the image and later use similarity algorithm to compare it with other images.

The output from the ML model will be then via the API will be relayed on the WebApp.

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6. MODEL:

A CNN is a Deep Learning system that really can accept an input image and provide meaning (learnable weights and biases) to various facets in the image, as well as differentiate between them. A ConvNet requires substantially less pre-processing than other classification algorithms. ConvNets can learn these filters/characteristics with adequate training, whereas simple techniques require hand-engineering of filters. A ConvNet's architecture is inspired by the Visual Cortex's organisation and is similar to the connectivity pattern of Neurons in the Human Brain. Individual neurons can really only react to stimuli in the Receptive Field, a tiny portion of the visual field. To span a distance, a number of comparable fields can be piled on top of one another.The convolution operation is represented in formula for the image under the two-dimensional data format, where the input is X and the convolution kernel is W.

$$S(i,j) = (X * W)(i,j) = \sum_m \sum_n X(m,n)W(i-m, j-n)$$

7. RESULTS & DISCUSSIONS:

Input **Output**

The end product is user will be able to upload images on the website and find outfits with similar patterns, colors, look and style according to his performance.

The reviewed papers has limitations. The primary focus of these paper are fashion recommendation-based model in last decade that explicitly described their frameworks, algorithms, and filtering techniques. However, we have made some additions to the model like we have increased the accuracy of prediction by several percentages. A review of the datasets used in fashion recommendation-based research publications could be conducted in future research. In addition, future assessments of fashion recommendation systems can use our proposed possible algorithms to evaluate the effectiveness of the recommender systems on any of the accessible fashion image datasets.

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8. CONCLUSION:

The main point which we are trying to resolve through this model is, while searching for an apparel finding the right design and colour is a big headache and we often tend to like outfits which are similar to the existing ones yet unique. This model does the job for you one can quickly take a photo of enticing apparel with their phones and post it to obtain recommended items in seconds with similar fashion and style. If they like it, they can even go straight to the internet purchasing page and buy it. When consumers find items they like but are unsure where to buy them or how to find more comparable apparel, the Outfit Recommendation System assists them in finding it.

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