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FASHION RECOMMENDATION USING DEEP LEARNING

Digambar Rathod[*1], Akash Tundare[*2], Piyush Shelke[*3], Shantanu Muneshwar[*4], Prof. Sachin L. Dawkhar[*5]

[*1,2,3,4]Student, Information Technology, Sinhgad College Of Engineering Pune, Pune, Maharashtra, India.

[*5]Professsor, Department Of Information Technology, Sinhgad College Of Engineering Pune, Pune, Maharashtra, India.

ABSTRACT

Recommendation systems are the techniques that are used to predict the rating one individual will give to an item or social entity. The items can include books, movies, restaurants and things on which individuals have different preferences. These preferences are being predicted using two approaches first content-based approach which involves characteristics of an item and second collaborative filtering approaches which considers user's past behavior to evaluate its choices. Choosing the clothes is act as important role in individual's life. By using the fashion recommendation system and virtual trial room it will become an easy for the user to get the recommendation of the image which they upload and can try on the different outfits online by on a screen using the system camera without wearing it physically. This project proposes a fashion recommendation system which will recommend clothing images supported the style sort of the provided clothing images. In this work, we focus on the images of upper body as well as the lower body clothing and with human model in the images. The proposed system shows that it can process the user's clothes from the images, identify the type and color of the outfit and finally recommend the most suitable outfit for the given occasion based on the user's existing clothes. The system provides the virtual trial room in which the user can see the clothes on his body without actually trying it. We explore machine and deep learning techniques to classify the type of clothes from images and to identify the color of the clothes. In this project we have come up with an idea to build a content-based recommendation system using ResNet-50 convolutional neural network.

Keywords: Fashion Recommendation System (FRS), Deep Learning, Convolutional Neural Network (CNN), K-Nearest Neighbors (KNN).

I. INTRODUCTION

In our digital world, recommender systems have seamlessly integrated into our online experiences, shaping interactions on platforms. These systems, powered by machine learning, analyze user preferences, providing tailored suggestions and transforming e-commerce and content consumption. Among these systems, fashion recommendations have become increasingly influential, offering users personalized clothing suggestions. Clothing, beyond its utilitarian purpose, is a powerful means of expression and communication. Recognizing this, the fusion of fashion recommendations with virtual try-on has emerged as a groundbreaking solution. This integration allows users to effortlessly receive personalized clothing suggestions based on uploaded images. Additionally, users can virtually try on outfits using their device's camera, revolutionizing the retail experience and offering unparalleled convenience to consumers and retailers alike. Traditionally, product recommend-dations relied on user behavior data and item similarity metrics. However, our project redefines this approach. We aim to identify apparel types and colours directly from images, leveraging pre-trained neural networks to extract deep visual features. These features form the basis for our Logistic Classifiers, achieving high accuracy in predicting both clothing type and color. This study explores the transformative potential of integrating image recognition, fashion recommendations, and virtual trial experiences. By doing so, it paves the way for a new era of interactive and personalized online shopping, enhancing the way users engage with fashion in the digital realm.

II. METHODOLOGY

Dataset Generation

A comprehensive Fashion Product Images Dataset with 44,000 products will be used in our study obtained from Kaggle. Every item has been carefully catalogued, complete with multiple category labels, thorough

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descriptions, and high-quality images. The comprehensive content of the dataset consists of expertly taken product photos, manually input label attributes, and insightful text that highlights key features of the products. Every product has an ID that makes it easy to reference it individually. For our application, we concentrated on pictures with simple backgrounds and just one identifiable person. Our research is based on this carefully selected dataset, which allows us to precisely investigate virtual trials and fashion recommendation systems.

Feature Extraction

To extract meaningful and discriminative features from our clothing images, advanced techniques such as deep learning and computer vision are used. We can use convolutional neural networks (CNNs) to learn high-level features that capture the visual appearance and characteristics of clothing items. We can also use generative adversarial networks (GANs) to synthesize realistic and diverse clothing images that can augment our dataset and enhance our recommendations. Furthermore, we can use techniques such as semantic segmentation, pose estimation, and face detection to locate and crop the clothing regions from the images and align them with the user's body shape and size.

Model Implementation

To implement a fashion recommendation system that can provide personalized and relevant suggestions to the user, we shall need to use machine learning algorithms that can learn from the user's preferences and feedback. We can use collaborative filtering to recommend clothing items that are similar to what the user or other users with similar tastes have liked or purchased before. We can also use content-based filtering to recommend clothing items that are similar to the user's query image or text. Moreover, we can use hybrid filtering to combine both methods and leverage the advantages of both approaches.

Algorithm

To enable the user to virtually try on the recommended clothing items in real-time, we shall need to use an algorithm that can overlay the clothing images on the user's video feed. We can use a technique called image warping to transform the clothing images according to the user's pose and perspective. We can also use a technique called image blending to blend the clothing images with the user's skin tone and background. Additionally, we can use a technique called image inpainting to fill in the missing or occluded regions of the clothing images.

Step 1: Input Camera Access: Use OpenCV for real-time video frame capture from the webcam.

Step 2: Pose Detection Pose Detection: Employ pre-trained pose detection models like OpenCV, MediaPipe Pose, or OpenPose to locate key points on the user's body.

Step 3: Clothing Selection Clothing Selection Interface: Create a user-friendly interface with Tkinter (Python) or React.js (web) for clothing selection.

Step 4: Clothing Overlay Clothing Overlay: Use OpenCV for image processing to overlay selected clothing items on the user's body. Advanced techniques like Mask R-CNN or U-Net for semantic segmentation and AR for realistic overlay can be applied.

Step 5: Interaction and Feedback User Interaction: Implement logic for user interactions using OpenCV (for hand gesture detection) or Pygame (interactive applications).

Step 6: Real-Time Rendering Real-Time Rendering: Continuously capture frames, detect pose, and overlay clothing items in real-time using OpenCV.

Step 7: User Experience Enhancements User Experience Enhancements: Incorporate features like clothing size adjustment, trying multiple items simultaneously, and viewing items from different angles. Use Pygame or Three.js for 3D visualization if necessary.

Step 8: Testing and Optimization Testing and Optimization: Employ Pytest for automated testing, identify performance bottlenecks, and optimize code and algorithms for real-time responsiveness.

Step 9: Deployment Deployment: Choose a platform (web, mobile, or desktop) and use frameworks like Flask, Django, React Native, Flutter, PyQt, or Tkinter for deployment.

Step 10: User Feedback and Iteration User Feedback and Iteration: Collect user feedback, analyze usage patterns, and iterate on the system based on suggestions. Consider incorporating feedback into future updates.

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III. MODELING AND ANALYSIS

Model Used:

Convolutional Neural Network (CNN):

A convolutional neural network (CNN) is constructed of multiple convolutional layers, where the number of layers is customized based on the desired recommendation system outcome. These layers can vary in terms of convolutional layers, filter size and fully connected layers. Researchers increase or decrease the depth of the network to achieve better results with the highest accuracy. Kernel and batch sizes are fixed depending on the desired input/output of the layer. There is an optional pooling layer to reduce the dimensionality of the data. The most common form of pooling layer is max pooling, which often ranges between 2 × 2 and 4 × 4. Softmax, Sigmoid, ReLU and TanH are the most common activation functions for CNN, which can be used either separately or in stacked form.

k-Nearest Neighbor (kNN):

The k-nearest neighbor (kNN) algorithm is a simple supervised learning algorithm which can be used to solve both classification and regression problems. It depends on labeled input data to produce output when given new unlabeled data. It is a non-parametric algorithm, so it does not make any assumptions on any underlying data distribution and does not use the training data points to perform any generalization. The output of the algorithm is based on the feature similarity.

In the KNN algorithm, the *k* most similar items are obtained by using different similarity measures such as Cosine, Euclidean, etc. The formula can be derived using simple Euclidean Distance as:

$$d(p,q) = d(q,p) = \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2 + \cdots + (q_n - p_n)^2} = \sqrt{\sum_{t=1}^{n}(q_t - p_t)^2}$$

Here, in Equation, *n* is the number of dimensions or features. The data point located at the minimum distance from the test point is assumed to belong to the same class.

CNNs are unparalleled in deciphering intricate visual patterns in fashion items, capturing essential details like textures and shapes when a user uploads an image. These deep learning insights create a rich dataset. To enhance accuracy further, k-Nearest Neighbors (kNN) steps in, measuring the similarity of these features against the broader dataset for a comprehensive comparison. By combining CNNs' detailed analysis with kNN's dataset-based precision, the system offers highly personalized and reliable fashion suggestions. This synergy optimizes accuracy, making the pairing of CNNs and kNN indispensable for fashion recommendation systems. The collaboration ensures precise matches, offering users tailored recommendations that reflect not only visual likeness but also the broader context within the dataset, enriching the user experience and solidifying the system's reliability in clothes recognition.

IV. RESULTS AND DISCUSSION

The project is designed to create a Fashion Recommender System (FRS) using Deep Learning modules. When code run, it shows the interface that is Python GUI. The result of this project is an interactive graphical user interface that allows you to upload fashion images and receive personalized fashion recommendations based on the uploaded images. Also it includes the virtual try features which give users a trial room like experience where user stand in front of a camera and try each recommended clothes virtually. The recommendations are displayed in real-time, making it a functional Fashion Recommender System.

Primarily, the focus of this comprehensive review paper was to explore fashion recommendation-based articles published in last decade that explicitly described their frameworks, algorithms, and filtering techniques. To achieve this goal, the articles were searched using keywords relevant to the topic title. However, it did not affect the article extraction methodology, because the authors included and studied all the research papers relevant to the research focus. However, future researchers could conduct a systematic literature review on the same topic. The future research can also conduct a review of the datasets that have been used in fashion recommendation-based research articles. Additionally, further reviews of fashion recommendation systems can apply our proposed potential algorithms to any of the available fashion image datasets to evaluate the performance of the recommender systems.

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V. CONCLUSION

Our Fashion Recommendation System serves as a valuable tool for users lacking fashion expertise, providing tailored outfit suggestions based on their wardrobe. While fashion trends evolve over time, our system adeptly cultivates user's fashion sense. The introduction of the Virtual Trial Room feature enhances user experience by enabling virtual outfit trials. Although recommendations depend on existing wardrobe items, our system successfully bridges the gap for fashion novices. Looking ahead, potential enhancements, such as detecting diverse designs and accommodating various occasions, promise an even more versatile and user-friendly platform, meeting the diverse fashion needs of users in the dynamic world of style.

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