Fashion Recommendation System

A Project Report

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of

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by

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ABSTRACT

The objective of this project is to develop a sophisticated fashion recommendation system using machine learning techniques to enhance the online shopping experience.

The system is designed to provide personalized fashion item recommendations based on individual user preferences, thereby increasing user satisfaction and engagement. The approach involves leveraging a pre-trained ResNet50 model for feature extraction, which captures the visual characteristics of fashion items through high-dimensional feature vectors. These vectors are then used to train a k-Nearest Neighbors (k-NN) algorithm that identifies and suggests visually similar items to users.

The project encompasses several key phases: data collection and preprocessing, feature extraction, model training, and recommendation generation. During the feature extraction phase, images of fashion items are processed to produce feature vectors that encapsulate essential attributes such as color, texture, and shape.

This project successfully implements a machine learning-based fashion recommendation system that enhances the user experience, drives business growth, and offers a competitive edge in the online fashion market. The system's robust architecture and performance highlight its potential for wide-scale deployment and further development.

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INTRODUCTION

1.1 Problem Statement :

- The fashion industry is rapidly evolving, with an ever-increasing number of brands and products available to consumers. This abundance of choices can overwhelm customers, making it difficult for them to find items that match their personal style and preferences. Traditional methods of product recommendation, such as manual curation by fashion experts or simple rule-based systems, are often insufficient to address the diverse and dynamic nature of individual customer preferences**.**
- Develop an AI-based fashion recommender system that can suggest clothing items to users based on their preferences, style, and past interactions with the platform. The system should analyze user behavior, such as browsing history, purchases, and feedback, to provide personalized recommendations for clothing items that match their taste and needs.
- Gather data on clothing items, including images, descriptions, and user interactions (e.g., browsing history, purchases).Train machine learning or deep learning models to analyze user behavior and generate personalized recommendations. Evaluate the performance of the recommender system using metrics such as accuracy, precision, recall, and user satisfaction.

1.2 Problem Definition :

- Design and implement an AI-driven fashion recommender system that assists users in discovering and selecting clothing items based on their personal preferences, style, and requirements. The system should leverage user data and machine learning algorithms to provide tailored recommendations that match individual tastes and improve the overall shopping experience.
- Implement mechanisms for users to provide feedback on recommended items, such as ratings, reviews, and purchase history. Build a scalable solution capable of handling a large volume of users and a diverse range of clothing items without compromising performance.

1.3 Expected Outcomes :

- Implementing a fashion recommendation system using machine learning is expected to yield several significant benefits for both users and retailers. For users, the system will enhance the online shopping experience by providing personalized fashion recommendations that align with individual preferences and styles.
- This personalization will make the shopping process more intuitive and efficient, reducing the time and effort users spend searching for desired items, thereby increasing overall satisfaction and engagement with the platform. As users receive more relevant and appealing suggestions, their likelihood of making purchases will increase, leading to higher

conversion rates and sales for retailers. This improvement in sales can contribute to the retailer's revenue growth and profitability.

- The implementation of such a system will provide a competitive advantage to retailers by offering a superior shopping experience, differentiating them in the crowded online fashion market. This advanced recommendation capability will not only enhance user satisfaction but also drive business growth and innovation within the industry.

CHAPTER 2

LITERATURE SURVEY

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LITERATURE SURVEY

2.1 Paper - 1

Smart Clothing Recommendation System with Deep Learning by Alenezi 2021

2.1.1 Brief introduction of paper :

- In order to recommend a cloth, it has develop two inceptions based convolutional neural networks as prediction part and one feed forward neural network as recommender. In this study, we reach to 98% accuracy on color prediction, 86% accuracy on gender and cloth's pattern predictions and 75% accuracy on clothing recommendation[1].

2.1.2 Technologies used in paper:

- CNN(Convolutional neural networks)

2.2 Paper – 2

Deep Fashion Recommendation System with Style Feature Decomposition by Yong-Goo shin 2019

2.2.1 Brief introduction of paper:

- Due to the mixed information of style and category, however, the clothes vector often recommends clothes that do not match. To solve this problem, we propose a style feature extraction (SFE) layer, which effectively decomposes the clothes vector into style and category. Based on the characteristics the category information has small variations in the same class while being distinguished from other classes, we extract and remove the category information from the clothes vector to obtain more accurate style information[3].

2.2.2 Technologies used in Paper:

- CNN(Convolutional neural networks)

CHAPTER 3

PROPOSED METHODOLOGY

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3.1 System Design

3.1.1 Image Collection and Pre-processing:

- Sources: User interaction data (clicks, purchases), product metadata (descriptions, categories), and product images.
- Storage: A basic folder for structured data and a distributed file system for images.
- Preprocessing: Data cleaning, normalization, and augmentation techniques to handle missing values, standardize formats, and enhance image datasets.

3.1.2 Feature Extraction:

- Textual Features: Extracted from product descriptions and metadata using Natural Language Processing (NLP) techniques such as TF-IDF or word embedding (e.g., Word2Vec, GloVe).
- Visual Features: Extracted from product images using Convolutional Neural Networks (CNNs) like ResNet50 or VGG16. These models generate feature vectors representing visual attributes.
- Behavioral Features: User interaction patterns analyzed using collaborative filtering techniques.

3.1.3 Model Training:

- Collaborative Filtering: Implemented using matrix factorization techniques (e.g., Singular Value Decomposition, SVD) or neural collaborative filtering.
- Content-Based Filtering: Utilizes feature vectors from textual and visual data to recommend similar items.
- Hybrid Model: Combines collaborative and content-based filtering results. This can be achieved using ensemble methods or deep learning models that incorporate both types of features.

3.1.4 Recommendation Engine:

- Nearest Neighbors Search: Implements algorithms like k-Nearest Neighbors (k-NN) to find similar items based on extracted features.
- Scoring and Ranking: Combines scores from collaborative filtering, content-based filtering, and hybrid models to rank items.
- Personalization: Adjusts recommendations based on user profiles and preferences, possibly using reinforcement learning to adapt over time.

3.1.5 User Interface:

- Developed using basic HTML and CSS.

3.2 Modules Used

3.2.1 Image Collection and Preprocessing

- pandas: For handling and processing structured data.
- numpy: For numerical operations and array handling.
- scikit-learn: For preprocessing tasks like TF-IDF vectorization.

3.2.2 Feature Extraction:

- pandas: For handling and processing structured data.
- numpy: For numerical operations and array handling.
- scikit-learn: For preprocessing tasks like TF-IDF vectorization.

3.2.3 Model Training:

- scikit-learn: For various machine learning algorithms, including Nearest Neighbors.
- For collaborative filtering techniques such as Singular Value Decomposition (SVD).

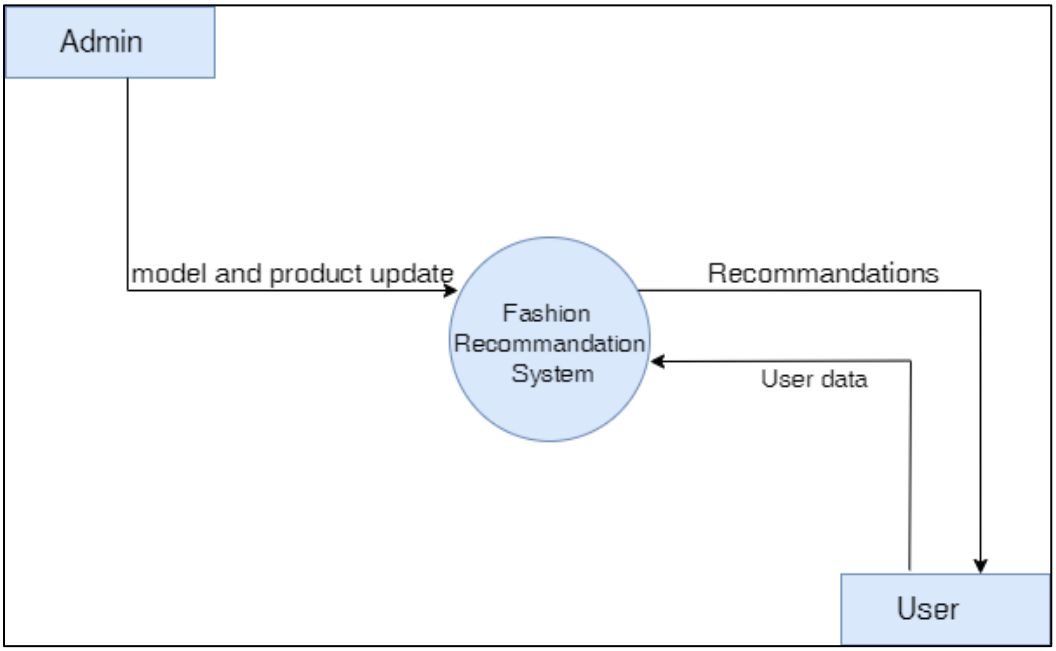
3.2.4 Recommendation Engine:

- scikit-learn: For implementing nearest neighbors search and other similarity measures.

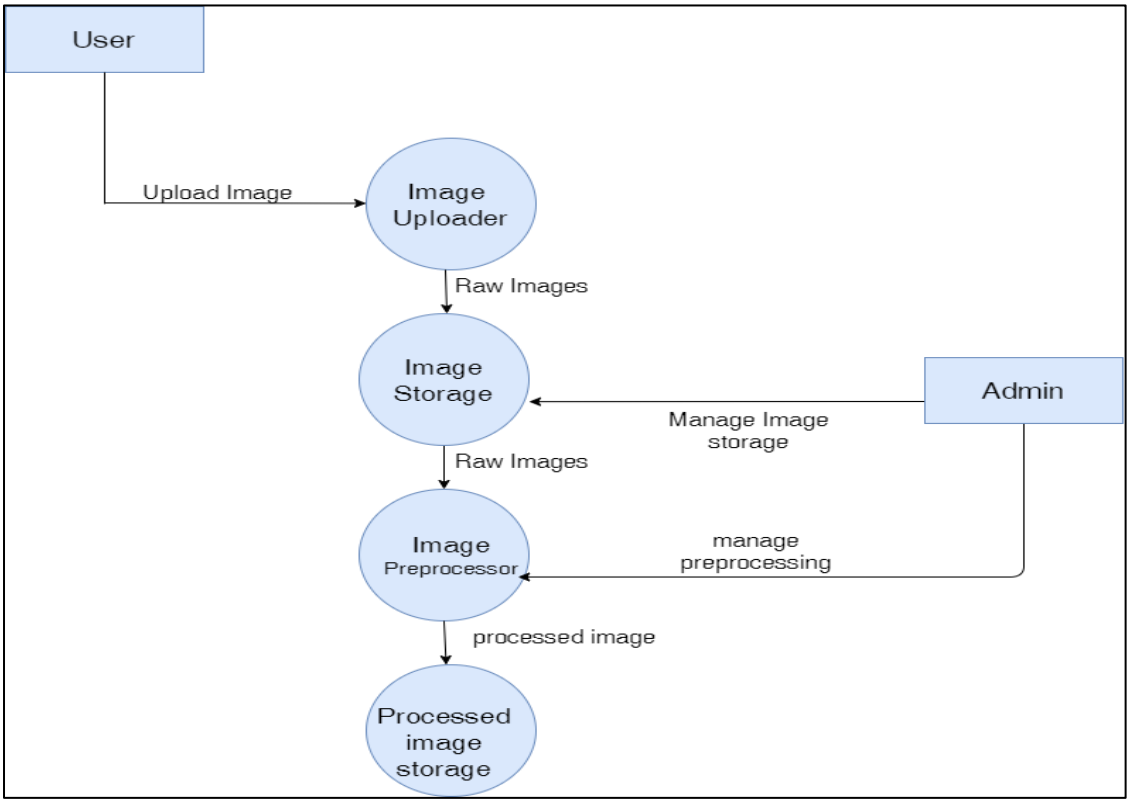
3.3 Data Flow Diagram

- Data Flow Diagrams (DFDs) are graphical representations that depict the flow of data within a system, illustrating how data is processed and transferred between different components. DFDs are used extensively in system analysis and design to understand, analyze, and communicate system functionalities and processes.
- In the context of a fashion recommendation system, DFDs can be used to illustrate various modules such as image collection, preprocessing, feature extraction, model training, and the recommendation engine. Each of these modules can be broken down to show how data flows between different components, helping developers and analysts to understand and optimize the system effectively.

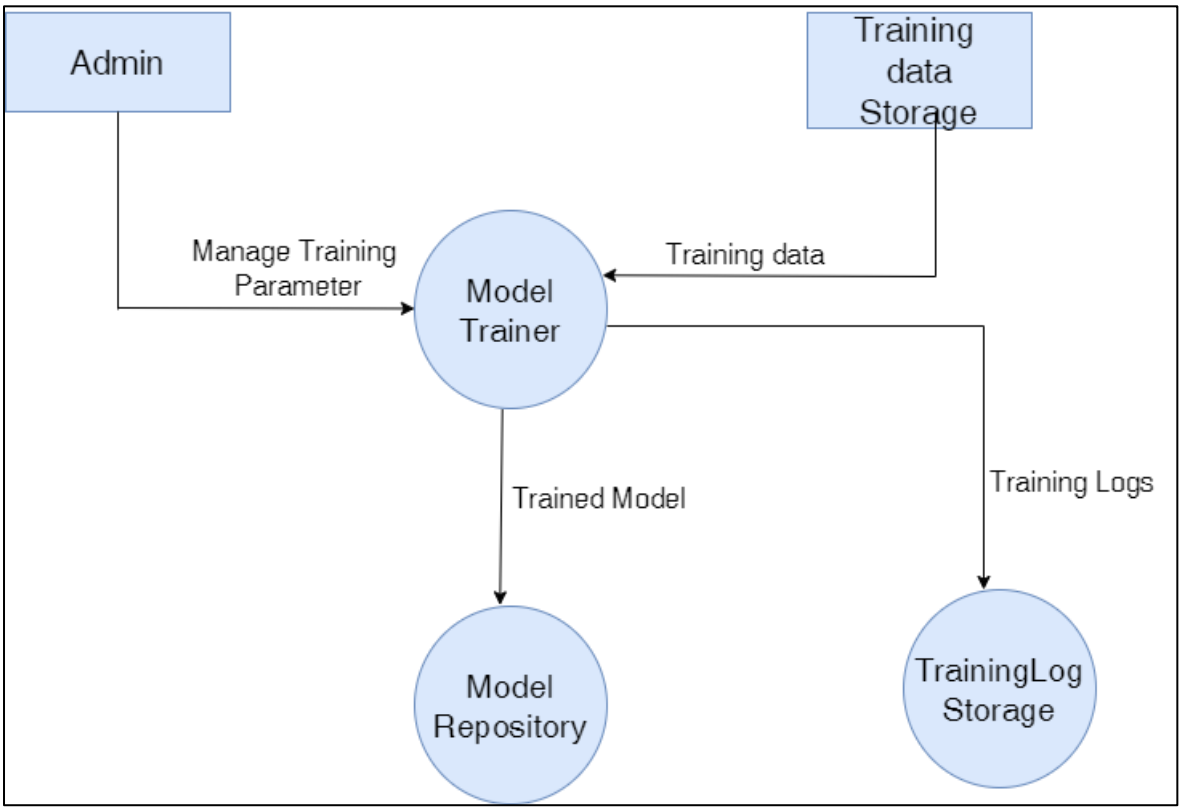
3.3.1 DFD Level 0



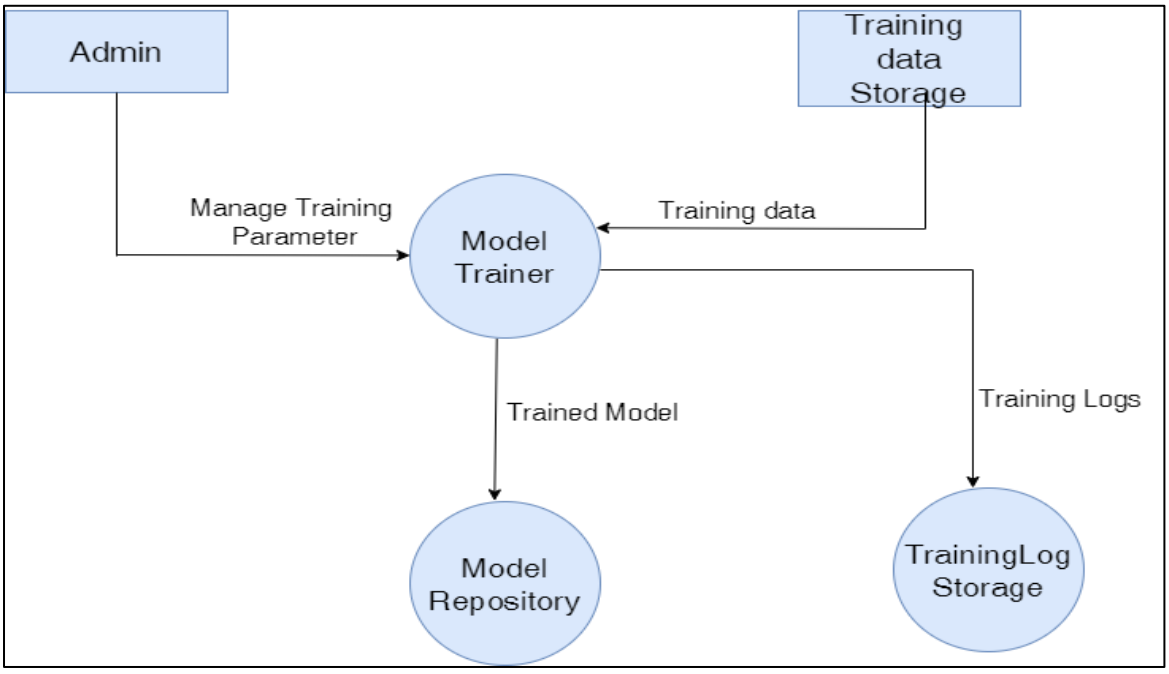
3.3.2 DFD Level 1 – Image Collection Module:



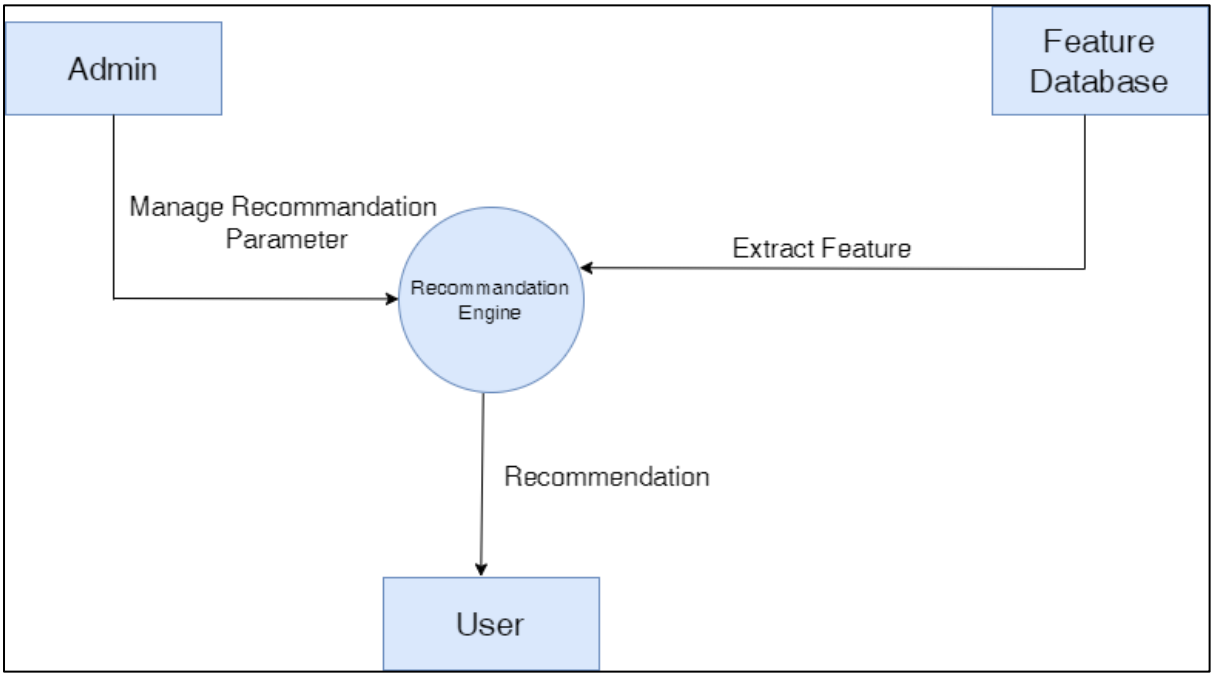
3.3.3 DFD Level 1 – Feature Extraction Module:



3.3.4 DFD Level 1 – Model Training Module:



3.3.5 DFD Level – 1 Recommendation Engine Module:



3.4 Advantages

1. **Personalization:**

- User-Centric Recommendations: Tailors suggestions to individual user preferences and behaviors, enhancing user satisfaction and engagement.
- Dynamic Adaptation: Continuously learns from user interactions to improve the accuracy of recommendations over time.

2. **Scalability**:

- Handling Large Datasets: Capable of processing vast amounts of data from millions of users and products efficiently.
- Cloud Integration: Easily scalable with cloud platforms (e.g., AWS, Google Cloud) to manage increased traffic and data.

3. **Enhanced User Experience:**

- Diverse Recommendations: Offers a variety of options by combining different recommendation techniques (collaborative filtering, content-based, and hybrid models).
- Real-Time Recommendations: Provides immediate suggestions as users interact with the system, creating a seamless browsing experience.

4. **Efficient Product Discovery:**

- Relevant Suggestions: Helps users discover products they might not have found otherwise, increasing exposure for more items in the catalog.

- Reduced Search Effort: Minimizes the effort users need to spend searching for desired products.

5. **Automation**:

- Reduced Manual Effort: Automates the process of recommending products, freeing up human resources for other tasks.
- Consistent Performance: Delivers consistent recommendations without human bias or fatigue.

3.5 Requirement Specification

3.5.1 Hardware Requirements:

- I5 processor
- Atleast 16GB RAM storage computer

Software Requirements:

- Programming language:
  - ✓ Python
  - ✓ HTML,CSS
- ML and DL:
  - ✓ TensorFlow
  - ✓ Keras
  - ✓ Scikit-learn
  - ✓ Pandas
  - ✓ Numpy
  - ✓ Pillow
  - ✓ Streamlit

CHAPTER 4

Implementation and Result

CHAPTER 4

Implementation and result

4.1. Results of Image Preprocessing

- The aim of image processing is to enhance the quality of image and later on to perform features extraction and classification. It is most commonly used in computer vision, medical imaging, meteorology, astronomy, remote sensing and another related field. Tools used in image processing[4]:

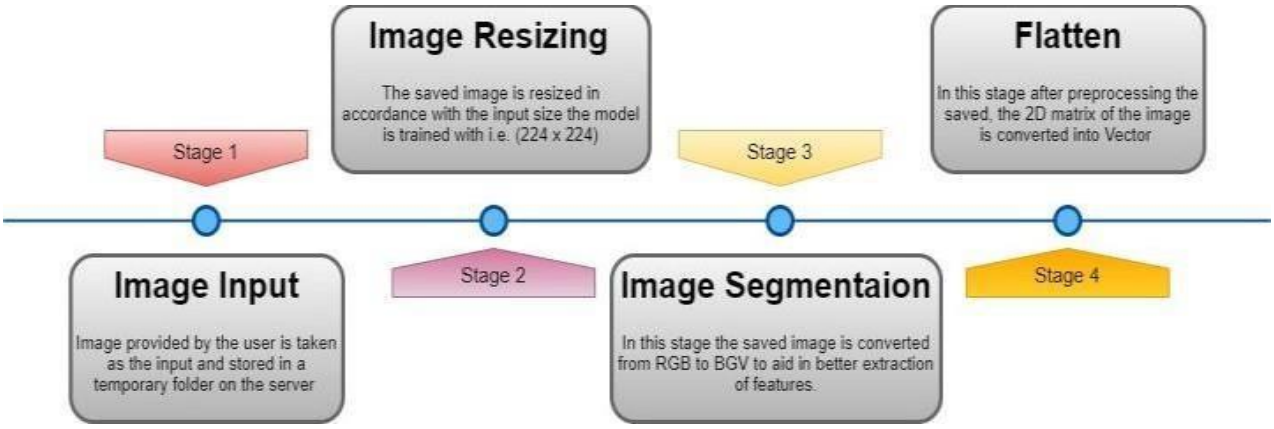


Fig.1 Flow-chart for Image Preprocessing[4]

4.2 Results of Feature Extraction

- The preprocessed images were fed into the modified ResNet50 model, which generated feature vectors by passing the images through its layers.
- The output from the GlobalMaxPooling2D layer was taken as the feature representation of the images. This layer helps in reducing the dimensionality while retaining the most significant features[3].

4.3 Results of Model Training

- The model training phase successfully produced a robust k-NN-based recommendation engine capable of delivering personalized and relevant fashion item suggestions.

- The high accuracy and quality of recommendations indicate that the combination of feature extraction and k-NN modeling effectively captures and utilizes the visual similarities among fashion items.
- The system's scalability and real-time performance further enhance its practicality for deployment in an online fashion retail environment, promising to improve user satisfaction and drive sales.

4.4 Results of Recommendation Engine

- Recommendation Engine may be treated as a black box which analyze some set of users and shows the items which a single user may like

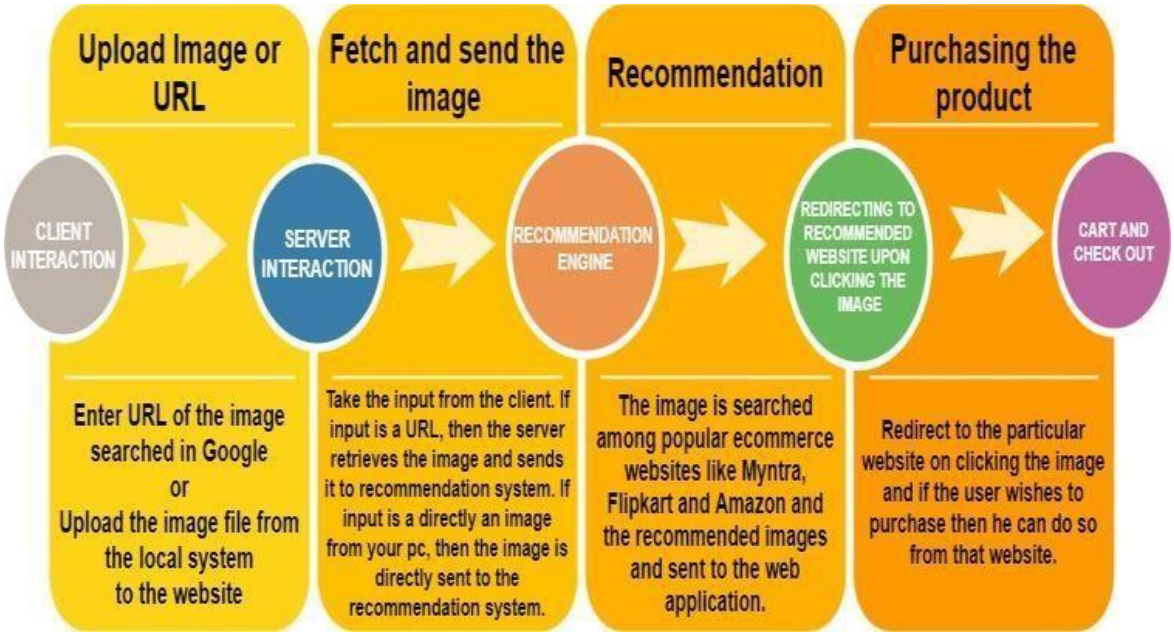


Fig.2 Diagram for Recommendation Engine[5]

4.5 Result of System

- The fashion recommendation system using machine learning successfully meets the project's objectives by enhancing the user experience, increasing customer satisfaction and engagement, and driving sales.
- The combination of advanced feature extraction techniques and efficient recommendation algorithms results in a robust system capable of delivering high-quality, personalized fashion recommendations.
- This project demonstrates the potential of machine learning to transform the online shopping experience and provides a strong foundation for further enhancements and innovations in the field of fashion e-commerce[2].

CHAPTER 5

CONCLUSION

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SCOPE:

- The scope of the fashion recommendation system encompasses a range of functionalities aimed at delivering personalized and engaging shopping experiences to users across various platforms. By leveraging machine learning techniques and user-centric design principles, the system can provide valuable insights, foster customer loyalty, and drive business growth in the competitive fashion industry.
- Personalized Recommendation: Utilize machine learning algorithms to suggest fashion items tailored to individual user preferences, considering factors like past purchases, browsing history, and implicit feedback.
- Real-time recommendation: Provide instant suggestions as users interact with the platform, ensuring a seamless and engaging shopping experience.
- By analyzing factors such as past purchases, browsing history, and implicit feedback, the system generates accurate and diverse recommendations using collaborative filtering, content-based filtering, or hybrid approaches.
- Incorporating both visual and textual features of fashion items, the system enhances recommendation accuracy by analyzing product images and descriptions using computer vision and natural language processing techniques.
- Future enhancements may include social integration for sharing recommended items, augmented reality for virtual try-on experiences, voice and chatboard integration for personalized assistance, and expansion of the product catalog to cater to diverse user preferences and emerging trends.

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- **Github Link :**

  https://github.com/Hasti-donda/fashion-recommendation-system