**Fashion Recommendation System Using Deep Learning-Based Feature Extraction**

**Abstract**

Fashion recommendation systems aim to enhance online shopping experiences by suggesting visually similar clothing items. Traditional recommendation models rely on text-based metadata, which lacks an understanding of visual aesthetics. This research proposes a deep learning-based fashion recommendation system leveraging ResNet50 for feature extraction and cosine similarity for image-based recommendations. Our approach extracts deep visual features from clothing images and identifies visually similar items. Experimental results demonstrate improved recommendations compared to metadata-based methods, highlighting the efficiency of deep learning in personalized fashion recommendations.

**1. Introduction**

**1.1 Background**

The online fashion industry has witnessed significant growth, necessitating efficient recommendation systems. Traditional recommendation engines use collaborative filtering or content-based filtering based on product descriptions, reviews, and user preferences. However, fashion recommendations require an understanding of **visual style, texture, and patterns**—features that textual data cannot capture effectively.

**1.2 Problem Statement**

Existing fashion recommendation systems rely heavily on textual descriptions, making them ineffective for personalized, image-driven recommendations. This research aims to develop a **deep learning-based fashion recommendation system** that extracts meaningful image features and identifies visually similar fashion items.

**1.3 Objectives**

* Utilize **ResNet50** for visual feature extraction from clothing images.
* Compute similarity using **cosine similarity** to recommend similar fashion items.
* Compare deep learning-based recommendations with traditional metadata-based methods.

**2. Literature Review**

**2.1 Existing Approaches**

* **Collaborative Filtering:** Uses user purchase history but fails for new users (cold start problem).
* **Content-Based Filtering:** Relies on textual attributes but lacks visual understanding.
* **Hybrid Approaches:** Combine metadata and image-based recommendations but require manual feature engineering.

**2.2 Deep Learning in Fashion Recommendations**

Deep learning models like **Convolutional Neural Networks (CNNs)** extract high-level image features, enabling **visual similarity-based recommendations**. CNN-based models outperform traditional methods by recognizing patterns, colors, and textures in clothing images.

**3. Methodology**

**3.1 Dataset**

We use a **fashion dataset** consisting of clothing images and metadata (styles.csv). The dataset includes attributes like category, brand, and description.

**3.2 Preprocessing Steps**

* **Image Resizing:** All images are resized to **224×224 pixels** to fit ResNet50 input dimensions.
* **Feature Extraction:** ResNet50 (pre-trained on ImageNet) is used to extract deep visual features.
* **Cosine Similarity Computation:** Identifies the most visually similar items.

**3.3 Model Architecture**

* **Feature Extractor:** ResNet50 (removing fully connected layers).
* **Similarity Calculation:** Cosine similarity measures closeness between feature vectors.

**4. Experimentation & Results**

**4.1 Experimental Setup**

The model was implemented in **Google Colab using TensorFlow and OpenCV**. We compared recommendations using deep learning features vs. metadata attributes.

**4.2 Performance Metrics**

* **Similarity Score Distribution:** Higher cosine similarity scores indicate visually closer items.
* **Recommendation Accuracy:** Measured using visual verification.

**4.3 Observations**

* Deep learning-based recommendations captured **style, texture, and color similarity** effectively.
* Metadata-based recommendations often failed when item descriptions were missing or inaccurate.

**5. Conclusion & Future Work**

**5.1 Conclusion**

This research demonstrates that deep learning significantly improves fashion recommendations by leveraging image-based feature extraction. Compared to traditional methods, our approach provides **more relevant and visually similar recommendations**, enhancing user experience.

**5.2 Future Work**

* Implement **Vision Transformers (ViTs)** for improved feature extraction.
* Enhance recommendations by combining **user preferences and visual features**.
* Deploy a real-time recommendation system in an e-commerce platform.