Journal of Artificial Intelligence and Cyber Security (JAICS)
An International Open Access, Peer-Reviewed, Refereed Journal

A Study on Fashion and Style Recommendation System using Machine Learning and Deep Learning Algorithms

1Mr. Mohammad Kaif M. Ismail , 2Miss Dnyaneshwari Pravin Garole,
3Miss Nikita Santosh Mirkar, 4Asst. Prof. Dr. A.S. Bharathy
[1,2, 3] Students, Department of Computer Science and Engineering,
Anuradha Engineering College, Chikhli
[4] *Assistant Professor, Department of Computer Science and Engineering,*
Anuradha Engineering College, Chikhli
[1]*mohammadkaif5849@gmail.com*, [2]*dnyaneshwarigarole@gmail.com*,
[2]*nikitamirkar2003@gmail.com*, [4]*santhembharathy@gmail.com*

ABSTRACT: A fashion recommendation system is a computer-driven solution that suggests clothing and accessories based on visual features extracted from images. People can choose cloths or other fashion accessories from a wide variety of products. The rise of e-commerce companies has significantly changed people's shopping style. Shoppers can pick out clothes and accessories from a wide variety of products, all matched to what they like, without getting off the couch. In this ever-changing world of online shopping, systems that suggest fashion and style ideas are key to making the experience better for users. These systems offer personalized choices based on what each person likes, what's trendy, and what fits the occasion. They don't just save time - They help users find unique styles that match their personality, making online shopping simple and enjoyable. This paper presents an AI-based fashion recommendation system that enables users to upload images of fashion items and receive similar product recommendations and style suggestions. The system utilizes deep learning-based feature extraction with MobileNet, a pre-trained convolutional neural network (CNN), to generate embeddings that capture visual attributes such as shape, color, and texture. These embeddings are then processed using k-Nearest Neighbours (k-NN) to find the most visually similar fashion items from a dataset. Additionally, a complementary style recommendation module suggests outfit pairings based on predefined category relationships. Unlike traditional recommendation systems that rely on user browsing history or purchase patterns, this approach is purely image-driven and requires no prior user data. The system is designed for fashion e-commerce platforms, mobile applications, and virtual styling assistants, offering an efficient, scalable, and user-friendly solution for personalized fashion discovery.

Keywords: MobileNet, Machine learning techniques, Nearest neighbour (k-NN), Deep learning, and Clothing Categories.

Corresponding Author: Mr. Mohammad Kaif M. Ismail
Student, Department of Computer Science and Engineering,
Anuradha Engineering College, Chikhli
Mail: mohammadkaif5849@gmail.com

I. INTRODUCTION

Finding the right outfit or fashion item can often be challenging, as fashion is highly subjective and personal. With the rise of e-commerce and online shopping, the number of available options has significantly increased, making it harder for consumers to find products that match their style. To address this issue, retailers are implementing fashion recommendation systems, which use machine learning to analyze consumer behavior and suggest personalized clothing and accessories. In the competitive fashion industry, personalization plays a key role in improving customer experience and increasing sales. By offering tailored recommendations based on individual preferences, fashion recommender systems help retailers differentiate themselves and enhance customer engagement [2]. These systems improve the shopping experience by reducing decision fatigue and allowing users to discover new fashion items more efficiently. There are several types of fashion recommendation systems, each with its own advantages and limitations. Collaborative filtering suggests products based on a user's past purchases and the behavior of similar users. While effective when large amounts of data are available, this method struggles with new users who have no purchase history (cold-start problem) [3]. Another approach is content-based filtering, where recommendations are generated based on the features of products the user has previously liked, such as color, material, or design patterns. This method works well when user preferences align with product attributes but may limit exposure to new and diverse fashion choices [4]. To overcome these limitations, hybrid recommendation systems combine multiple approaches, integrating data from user behavior, product attributes, and even social media activity to generate more accurate and diverse recommendations [5]. These systems help users discover new styles they might not have considered on their own. Additionally, many modern recommendation engines use deep learning techniques such as convolutional neural networks (CNNs) and transformer-based models to improve visual similarity matching and enhance recommendation quality. Modern fashion recommender systems also incorporate additional interactive features to improve user experience. Visual search allows users to upload an image to find similar fashion items, while style quizzes help them refine their preferences. Some systems also provide personalized outfit recommendations, assisting users in creating well-matched ensembles based on their fashion preferences. As artificial intelligence continues to evolve, fashion recommendation systems are expected to become even more accurate, offering a seamless and engaging shopping experience for consumers worldwide.

II. LITERATURE REVIEW

The fashion industry has evolved rapidly with advancements in artificial intelligence (AI) and machine learning (ML). Fashion recommendation systems have become essential tools in e commerce, helping retailers provide personalized shopping experiences by analyzing consumer behavior, purchase history, and browsing patterns. Researchers have explored various AI-driven techniques to improve recommendation accuracy and user engagement. This section presents recent advancements in fashion recommendation systems.

Advancements in AI-Driven Fashion Recommendation Systems: With the vast number of fashion choices available, AI-based recommendation models have been developed to help users discover relevant items efficiently. A review by Kalyan et al. (2023) summarized various machine learning techniques in fashion recommender systems, emphasizing the importance of contextual compatibility alongside similarity-based recommendations [1].

Deep Learning and Transfer Learning for Fashion Recommendations: Deep learning techniques have significantly improved recommendation accuracy by enhancing feature extraction and classification capabilities. Elsayed et al. (2022) proposed an ensemble model combining five pre trained architectures, including MobileNet and DenseNet, which, when integrated with transfer learning, enhanced the ability to classify and retrieve fashion items effectively [2].

Self-Attention Mechanisms in Fashion Recommendations: Self-attention mechanisms have been widely adopted to improve personalization in fashion recommendations. Celikik et al. (2022) introduced a self-attention-based model that considers interactions between fashion products, outfits, and influencers. This method incorporates both short-term and long-term customer preferences, leading to better engagement and improved retention rates [3].

Contrastive Learning for Interactive Recommendations: Recent research has explored contrastive learning approaches to enhance interactive recommendation models. Celikik et al. (2022) developed a framework that refines fashion recommendations by capturing user intent from natural language text. This approach, which combines CLIP embeddings with neural network layers for personalization, has shown significant improvements in retrieval accuracy [4].

Sequential Large Language Models (LLMs) in Fashion Recommendation: Large language models (LLMs) are increasingly being used in sequential recommendation frameworks to improve fashion predictions. Celikik et al. (2023) introduced a model that fine-tunes LLMs with recommendation specific prompts, leveraging mix-up-based retrieval techniques to enhance the personalization and efficiency of fashion recommendations [5].

Fashion Datasets and AI-Driven Personalization : Large-scale datasets such as DeepFashion and Fashion MNIST have contributed significantly to the development of fashion recommendation systems. Suvarna and Balakrishna (2022) explored the use of convolutional neural networks (CNNs) for classifying fashion images, achieving notable improvements in retrieval accuracy. Additionally, AI models now integrate sentiment analysis and social media trend tracking to refine recommendations [7].

Industry Applications and AI Integration in Fashion: AI is playing a crucial role in transforming the fashion retail industry. Companies such as Vestiaire Collective have implemented AI-powered tools to enhance search functionality, pricing optimization, and visual similarity-based recommendations. These advancements have resulted in improved user engagement and higher conversion rates in online fashion retail [6].

Generative AI in Fashion: Generative AI is being increasingly utilized in fashion design, enabling the creation of unique clothing items based on existing trends. According to Vogue Business (2023), AI-generated fashion concepts have accelerated the production process while maintaining originality and aesthetic appeal [9].

AI-Driven Fashion Trend Analysis: AI has also been applied to analyzing fashion trends by processing vast amounts of social media and fashion-related content. By identifying emerging patterns and consumer preferences, AI models help designers and retailers stay ahead of trends, leading to more relevant and timely product offerings [10].

Sustainable Fashion Recommendations: AI-powered recommendation systems are now focusing on sustainability by suggesting eco-friendly fashion choices. These models analyze the environmental impact of materials and production methods, encouraging consumers to make more sustainable purchasing decisions. TIME (2024) discusses how AI is shaping the future of sustainable fashion, particularly in fast fashion brands [11].

III. METHODOLOGY

Fashion recommendation systems have become essential in e-commerce, helping users navigate the overwhelming number of clothing options available online. Since customers cannot physically examine products before purchasing, uncertainty regarding fit, texture, and quality remains a significant challenge. To address this, AI-driven recommendation models are being developed to enhance personalization and improve the shopping experience.

Our approach focuses on an image-based recommendation system that suggests fashion products based on visual similarity rather than user browsing history or purchase data. The system allows users to upload an image of a fashion item, which is processed using a pre-trained convolutional neural network (CNN), MobileNet, to extract key features such as color, texture, and patterns. These features are compared with a precomputed dataset using k-Nearest Neighbors (k-NN) to retrieve the most visually similar products.

In addition to finding similar products, the system also suggests complementary fashion items, enabling users to assemble well-coordinated outfits. Unlike traditional recommendation systems that rely on metadata and user behavior tracking, this method provides unbiased, visually driven suggestions, making it particularly effective for new users with no purchase history. Studies have shown that integrating deep learning models for visual-based

recommendations enhances both accuracy and user engagement in online fashion retail [3][4]. The availability of large datasets, such as DeepFashion and Fashion MNIST, has further contributed to improving recommendation models by enabling better classification and feature extraction [5].

By leveraging deep learning for feature extraction and machine learning for similarity matching, the system offers an efficient and scalable solution that can be integrated into various e commerce platforms to enhance product discovery and user experience.

IV. RESULTS AND DISCUSSION

Recent advancements in fashion recommendation systems have significantly enhanced the personalization and efficiency of online shopping experiences. For instance, a study by Suvarna and Balakrishna (2022)[7] introduced a deep convolutional neural network (CNN) model that achieved a notable 36% improvement in accuracy over previous models, effectively categorizing fashion products and addressing the challenges posed by the vast diversity in fashion items. Similarly, Chen et al. (2025)[8] proposed a method that integrates image attributes and aesthetics assessment, leading to more accurate personalized fashion recommendations and mitigating the cold-start problem commonly faced in recommendation systems. These developments underscore the pivotal role of artificial intelligence in refining recommendation algorithms, thereby enhancing user satisfaction and engagement in the fashion industry.

The development of our proposed fashion recommendation system demonstrates the effectiveness of deep learning-based feature extraction for personalized fashion suggestions. By leveraging MobileNet for visual feature extraction and k-Nearest Neighbors (k-NN) for similarity matching, the system efficiently identifies fashion items that resemble the user's uploaded image. The inclusion of a style recommendation module further enhances the system by suggesting complementary fashion pieces, making it more useful for users looking for outfit ideas.

One of the key strengths of this approach is that it does not rely on user browsing history or purchase data, unlike traditional recommendation systems. This ensures that recommendations are purely image-driven, making them accessible to both new and returning users without requiring prior interactions. Additionally, using pre-trained deep learning models allows the system to generate accurate feature embeddings without extensive computational resources.

However, the system also has some limitations. The k-NN algorithm works well for small to medium sized datasets but may struggle with scalability as the dataset grows. A deep learning based similarity model, such as a Siamese network or Triplet Loss-based approach, could improve the efficiency and accuracy of recommendations. Another limitation is that the recommendations are purely visual, meaning the system does not consider fashion trends, seasonal styles, or personal preferences unless explicitly stated in the dataset.

In the future, integrating e-commerce APIs could enable real-time product recommendations from online stores, making the system more practical for commercial applications. Additionally, improvements in fashion compatibility analysis using advanced deep learning models could further refine the style recommendations, ensuring that suggested outfits align with evolving fashion trends.

Overall, this project provides a solid foundation for AI-driven fashion recommendations and demonstrates the potential of deep learning in enhancing user experiences in the fashion industry. With further refinements, it could become a valuable tool for e-commerce platforms, virtual shopping assistants, and personal stylists.

V. CONCLUSION

For anyone looking for advice on how to dress in various contexts or to stay up to date with the latest trends, fashion guidelines can be a useful resource. But it's crucial to remember that the fashion industry is a subjective and dynamic one, thus ideas rather than rigid guidelines should be followed. It's crucial to take the source into account while looking for fashion advice. While some suggestions could favour particular brands or fashions, others might put functionality and comfort ahead of style. When assessing suggestions, it's also critical to take your body type and personal style into account. Following celebrities or influencers who post their clothing and style advice on social media is a common way to get fashion advice. Although this might serve as a useful source of inspiration, it's crucial to keep in mind that these people frequently have access to high-end apparel and stylists, which may be beyond the means of the typical person. Another strategy is to look for stylists or fashion bloggers who specialize in designing looks for particular body shapes or events. These people can provide tailored suggestions and guidance on how to put together a wardrobe that complements your lifestyle and sense of style. In the end, how you feel about the clothes is the most crucial consideration when choosing what to wear. It's up to each person to decide what makes them feel comfortable and confident, but fashion suggestions can be a good place to start. The important thing is to wear it with confidence and personalize it, whether it's a current statement item or a timeless wardrobe staple

REFERENCES:

1. Kalyan, K. P., Soni, P., Srikanth, T., Singh, M., & Verma, B. K. (2023). *A Comprehensive Review on Fashion Recommender System Using Machine Learning Techniques.* SSRN. 2. Elsayed, S., Brinkmeyer, L., & Schmidt-Thieme, L. (2022). *End-to-End Image-Based Fashion Recommendation.* arXiv preprint arXiv:2205.02923.

3. Celikik, M., Wasilewski, J., Mbarek, S., Celayes, P., Gagliardi, P., Pham, D., Karessli, N., & Ramallo, A. P. (2022). *Reusable Self-Attention-based Recommender System for Fashion.* arXiv preprint arXiv:2211.16366.

4. Celikik, M., Kirmse, M., Denk, T., Gagliardi, P., Mbarek, S., Pham, D., & Ramallo, A. P. (2022). *Outfit Generation and Recommendation—An Experimental Study*. arXiv preprint arXiv:2211.16353.

5. Celikik, M., Wasilewski, J., & Ramallo, A. P. (2023). *Reusable Self-Attention Recommender Systems in Fashion Industry Applications.* arXiv preprint arXiv:2301.06777. 6. Vestiaire Collective. (2023). *How Vestiaire is Improving Fashion Treasure Hunts with AI.* Vogue Business.

7. Suvarna, B., & Balakrishna, K. (2022). *An Efficient Fashion Recommendation System using a Deep CNN Model*.

8. Chen, C., Mo, F., Fan, X., & Yamana, H. (2025). *Personalized Fashion Recommendation with Image Attributes and Aesthetics Assessment*.

9. Vogue Business. (2023). *Generative AI Hits a Fashion Acceleration Point.* Retrieved from https://www.voguebusiness.com.

10. API4AI. (2024). *Top AI Trends for the Fashion Industry in 2025.* Medium. Retrieved from https://medium.com.

11. TIME. (2024). *Shein, AI, and the Future of Fast Fashion.* Retrieved from https://time.com