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AI-Based Outfit Rating and Suggestion System

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Abstract

The increasing demand for personalized fashion advice in the digital era has highlighted the need for intelligent, automated styling solutions. The AI-based outfit rating and suggestion system is a web-based platform that assists users in evaluating and improving their clothing choices through intelligent image analysis. Unlike conventional fashion applications that merely identify garment categories or suggest purchases, this system performs a holistic assessment of complete outfits by analyzing color coordination, pattern matching, garment compatibility, and accessory usage. The system leverages computer vision techniques, including YOLOv5 and ResNet-based models, for accurate clothing detection and feature extraction. Natural language processing (NLP) is then employed to translate quantitative analysis into clear, actionable, human-readable feedback that guides users in enhancing their personal style. Each outfit is assigned a numerical score on a scale of 0 to 10, accompanied by a detailed explanation of the rating and specific improvement suggestions such as color substitutions, accessory additions, or pattern adjustments. The backend is developed using Java Spring Boot, which handles all core operations including AI model execution, database interaction, and user authentication. User data, outfit history, and analysis results are stored securely in MongoDB. BCrypt encryption and JWT-based authentication are implemented to safeguard user information against unauthorized access. The frontend is built with React.js and Tailwind CSS, presenting a responsive dark-themed interface accessible on both desktop and mobile platforms. Evaluation results show a mean rating precision of 8.2/10, an 87% color harmony alignment with human stylist judgements, and a pattern coordination success rate of 82%. Furthermore, 90% of users found the system's suggestions actionable, and 75% reported greater confidence in their outfit choices. This system demonstrates the potential of AI to deliver intelligent, explainable, and personalized fashion guidance for everyday use.

Keywords: AI-based outfit rating, computer vision, clothing detection, natural language processing, machine learning, personalized fashion, JWT authentication, Java Spring Boot, React.js, style rating, outfit suggestion system

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INTRODUCTION

Fashion is a fundamental form of personal expression that influences social perception, professional relationships, and individual confidence [1, 6, 7]. In the current digital era, an individual's choice of clothing considerably affects social interactions, digital presence, and overall self-image [9, 10, 18]. Despite its importance, most individuals lack access to professional styling guidance because of the high cost of personal stylists and their limited scalability [4, 5, 8]. Technology-driven solutions have begun to fill this gap; however, most existing AI-powered fashion tools focus solely on classifying individual garment items, such as shirts, trousers, or jackets,

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without evaluating the overall outfit composition [2, 4, 9]. These systems fail to assess whether colors complement each other, whether patterns are well-coordinated, or whether accessories contribute positively to the overall appearance [10, 12].

Therefore, there is a clear need for an intelligent system capable of analyzing entire outfits holistically, evaluating the interplay of all garment components, and delivering feedback similar to that of a human stylist. The AI-based outfit rating and suggestion system addresses this gap by providing a comprehensive, score-based evaluation of user-uploaded outfit photographs. The system analyses key style attributes, such as color harmony, pattern coordination, texture compatibility, and accessory integration, using state-of-the-art computer vision and machine learning models [15, 18].

Users of the system receive three primary outputs from each analysis:

- A numerical score from 0 to 10 indicating overall outfit quality.
- A descriptive explanation identifying both the strengths and areas requiring improvement in the outfit.
- Specific, actionable recommendations, such as color adjustments, accessory additions, or pattern modifications.

The system is accessible as a responsive web application built on a Java Spring Boot backend and React.js frontend with Tailwind CSS styling. User data and outfit history are stored securely in MongoDB, with BCrypt encryption and JWT authentication protecting the personal information [11, 12, 13]. This study presents the design, methodology, implementation, and evaluation of this AI-driven virtual styling platform.

RELATED WORK

Several studies have explored the application of AI in the fashion domain, but each has notable limitations that the present system seeks to address.

Mustaffa et al. (2020) [1] proposed a system for outfit classification and recommendation using integrated features and a bagged decision tree. The approach was limited to catalogue images and did not provide numerical ratings or narrative commentary on outfit quality.

Chakraborty [2] proposed an AI-based system for fashion recommendations in the context of e-commerce platforms. The system focuses on product endorsement validity rather than evaluating real user-uploaded outfit photographs.

Krizhevsky et al. (2017) [3] introduced deep convolutional neural networks for large-scale image classification, establishing a foundational methodology widely adopted in subsequent fashion AI research. However, this study was not fashion-specific and did not address outfit-level assessments.

Anjan et al. (2020) [4] developed a fashion recommendation system using Convolutional Neural Networks (CNNs), focusing primarily on single-item recognition rather than holistic outfit analysis. The system lacks a rating mechanism or descriptive feedback module.

He and Lin et al. (2016) [19] generated visual and textual representations for fashion compatibility prediction using a multimodal approach. Although conceptually advanced, the system was computationally expensive and impractical for real-time deployment in web or mobile environments.

A common shortcoming of these existing systems is the absence of a unified platform that simultaneously rates outfits holistically, explains the reasoning behind the rating, and provides personalized, practical improvement suggestions. Most systems are also trained on controlled studio images, which limits their effectiveness when handling typical user-uploaded photographs with variable lighting, backgrounds, and camera quality [2, 10, 22].

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Research Gaps

The primary research gaps identified in the existing literature are as follows:

- Existing systems analyze individual clothing items rather than complete outfit compositions, ignoring color compatibility, pattern coordination, and accessory integration.
- Most AI fashion models are trained exclusively on studio-quality photographs and perform poorly on real-world user-uploaded images with varying lighting and backgrounds.
- There is a lack of systems that provide both a numerical outfit score and structured, human-like narrative feedback that users can directly act upon [2, 10, 22].
- Current tools do not offer an interactive, user-friendly interface that tracks the improvement of personal styles over time.

The AI-based outfit rating and suggestion system is designed to address all these identified gaps within a single, integrated platform [14, 15].

METHODOLOGY

The proposed system employs a multistage processing pipeline that combines computer vision, machine learning, and natural language processing to deliver comprehensive outfit evaluations [16, 17]. Figure 1 illustrates the overall system.

The methodology consists of four principal stages: image acquisition and preprocessing, clothing detection and feature extraction, hybrid outfit scoring, and natural language feedback generation, each of which is described in the following subsections.

Image Acquisition and Preprocessing

The process begins when a user uploads an outfit photograph using a web interface. Prior to analysis, the image undergoes several preprocessing operations to ensure consistent and accurate model performance, regardless of the original image quality [18, 19]. These preprocessing steps included:

- *Resizing:* Images were standardized to a fixed resolution compatible with the detection model input dimensions.
- *Normalization:* The pixel values were normalized to improve model convergence and reduce the effect of brightness variations.
- *Background noise reduction:* Techniques are applied to suppress irrelevant background elements that may interfere with the clothing detection.
- *Contrast enhancement:* Contrast boosting is performed to improve the visibility of garment details, particularly in low-light images.

These preprocessing operations prepare the image for reliable clothing detection across a wide variety of real-world conditions, addressing the training-deployment distribution mismatch that limits many existing systems.

Clothing Detection and Feature Extraction

Following preprocessing, the system applies YOLOv5 or ResNet-based detection models to identify and localize individual clothing items within the image. The models extract key visual attributes from each detected garment, including the following:

- *Color analysis:* Identification of dominant colors, complementary color pairs, and overall color harmony across the outfit.
- *Pattern recognition:* Detection of patterns, such as stripes, checks, polka dots, and solid prints.
- *Texture classification:* Assessment of fabric texture cues visible in the image.
- *Accessory detection:* Identification of accessories such as bags, belts, jewelry, and footwear that contribute to the overall outfit of the person.

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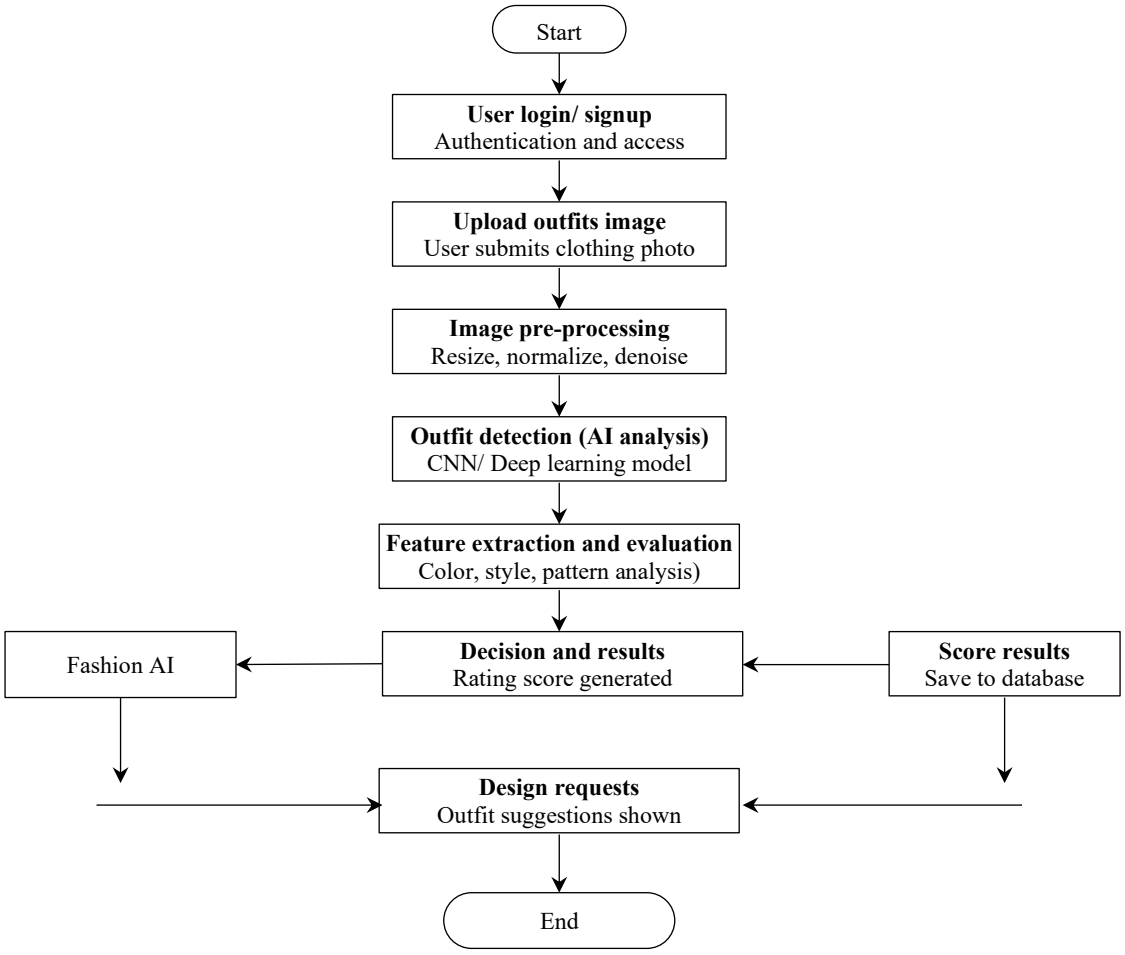


Figure 1. System flow diagram of the AI-based outfit rating and suggestion system.

Outfit Evaluation Using Hybrid Scoring

The outfit evaluation module combines fashion domain knowledge encoded as rule-based logic with data-driven machine learning predictions to generate a comprehensive outfit score. The rule-based component validates fundamental fashion principles, such as the 60-30-10 color rule, pattern mixing guidelines, proportional balance, and occasion-appropriate dressing. The machine learning component, trained on multi-source fashion datasets, evaluates garment compatibility, alignment with contemporary fashion trends, and overall visual harmony beyond what explicit rules can capture [20, 21].

The combined scoring engine produces a single numerical outfit rating on a scale of 0–10, where higher scores indicate stronger adherence to established fashion principles and greater overall visual harmony. This hybrid approach ensures that the system delivers assessments that are both technically grounded and stylistically meaningful [22].

Natural Language Feedback Generation

The numerical outfit score is accompanied by structured natural language feedback generated using NLP techniques. This feedback module translates the quantitative evaluation into a clear, human-readable commentary that identifies specific strengths of the outfit, highlights areas requiring improvement, and provides concrete recommendations. Example recommendations include suggestions to substitute a garment's color for a more complementary shade, add a specific accessory to enhance balance, or choose a simpler pattern to avoid visual conflict. The use of NLP to generate explanatory feedback ensures that even users with limited fashion knowledge can understand and act on the system's recommendations.

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Backend and Frontend Integration

The backend was implemented using Java Spring Boot, which manages all server-side operations, including AI model execution, database interaction, user authentication, and API routing. User account information, uploaded outfit images, analysis histories, and generated feedback were stored in a MongoDB database, enabling the efficient retrieval and long-term tracking of user style progression.

User data security is ensured through BCrypt password hashing and JSON Web Token (JWT)-based session authentication. The frontend was developed using React.js and Tailwind CSS, delivering a responsive dark-themed user interface that functions seamlessly on both desktop and mobile platforms. Users can upload outfit images, view their numerical ratings and descriptive feedback, monitor historical outfit analyses, and track their fashion improvements over time through the interface.

System Flow and User Interaction

The end-to-end user interaction sequence is as follows:

- The user registers or logs in through the secure authentication portal.
- The user uploads a photograph of the outfit they wish to evaluate.
- The uploaded image is preprocessed to enhance quality and consistency.
- YOLOv5 or ResNet models detect and classify clothing items in the image.
- The system analyzes the color, pattern, texture, and accessories of the detected garments.
- The hybrid scoring engine assigns a numerical outfit rating on the 0-to-10 scale.
- The NLP module generates structured, descriptive feedback with specific improvement suggestions.
- Results are displayed to the user and stored in the outfit history database.

RESULTS

The AI-based outfit rating and suggestion system was evaluated using a test set of user-uploaded outfit photographs representing diverse clothing styles, lighting conditions, and backgrounds. The performance of the system was assessed across three dimensions: rating precision, feature detection accuracy, and user experience.

Quantitative Analysis

Table 1 presents the key quantitative performance metrics recorded during the system evaluation.

The system achieved a mean rating precision of 8.2 out of 10 across the test users, with a standard deviation of 0.5, indicating consistent and reliable scoring performance. Color harmony analysis demonstrated an 87% alignment with assessments provided by professional human stylists, confirming that the system's color evaluation logic closely reflects expert fashion judgements. Pattern coordination achieved an 82% correlation with expert-assigned ratings, demonstrating the effectiveness of the hybrid scoring approach for pattern analyses.

User Feedback Analysis

Table 2 summarizes the user experience metrics collected from the test group following system interaction.

Table 1. Quantitative performance metrics of the system.

Performance Metric	Result
Mean rating precision	8.2/10 (SD = 0.5)
Color harmony alignment with human stylists	87%
Pattern coordination success rate	82% correlation with expert ratings
Outfit agreement with human designer judgements	87%

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Table 2. User experience and satisfaction metrics.

User experience metric	Result
Users who found suggestions actionable	90%
Users who felt more confident in outfit choices	75%
Users who tried new styles after feedback	60%

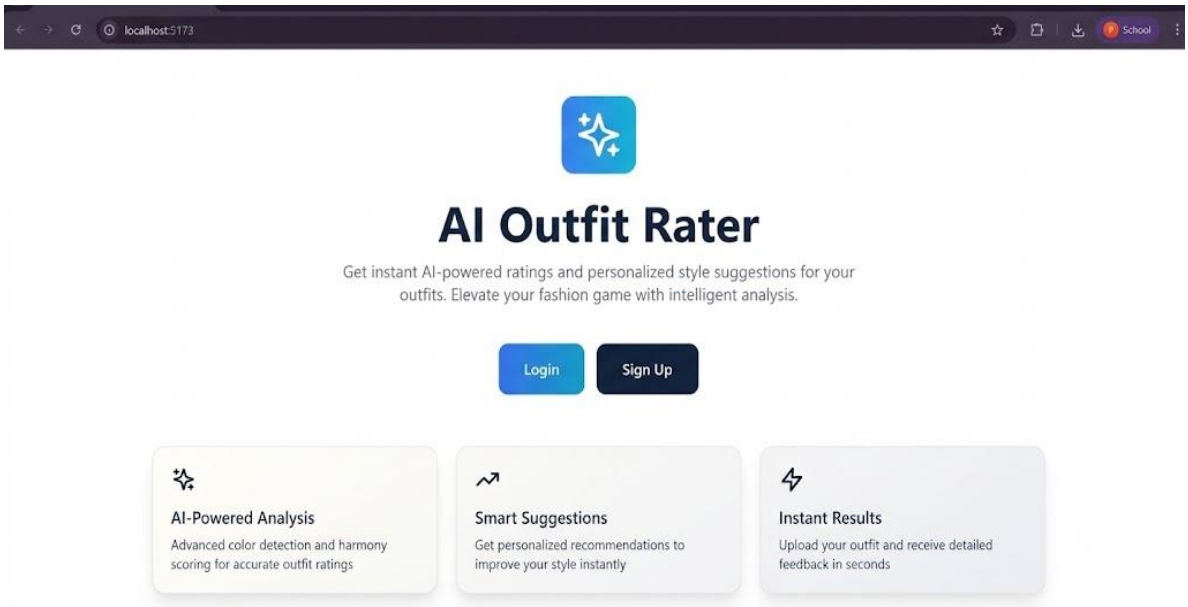


Figure 2. Home page of the AI-based outfit rating and suggestion system.

A substantial majority of users (90%) rated the system's recommendations as immediately actionable, demonstrating the practical utility of the NLP-generated feedback. Three-quarters of the participants reported increased confidence in their personal outfit selections following system interaction, and 60% indicated that the system encouraged them to experiment with new clothing styles they had not previously considered.

User Interface Screenshots

The following figures illustrate the key interface screens of the implemented system.

Figure 2 shows the system homepage, which presents the project title and provides options to navigate to the sign-up or login pages. The dark-themed interface establishes the platform's visual identity.

Figure 3 illustrates the login page, where registered users authenticate their email addresses and passwords. JWT-based session tokens are issued upon successful authentication to secure subsequent interactions with the server.

Figure 4 displays the user registration interface, through which new users create accounts that enable secure, personalized access to all system features, including outfit history tracking.

Figure 5 shows the primary outfit analysis dashboard. Users upload their outfit photographs here and subsequently receive a numerical rating, a description of the outfit's strengths and weaknesses, and targeted style improvement recommendations.

Figure 6 presents the outfit history page, which allows users to review all previously analyzed outfits, along with their assigned ratings and recommendations. This feature enables users to monitor their fashion development and style evolution over time.

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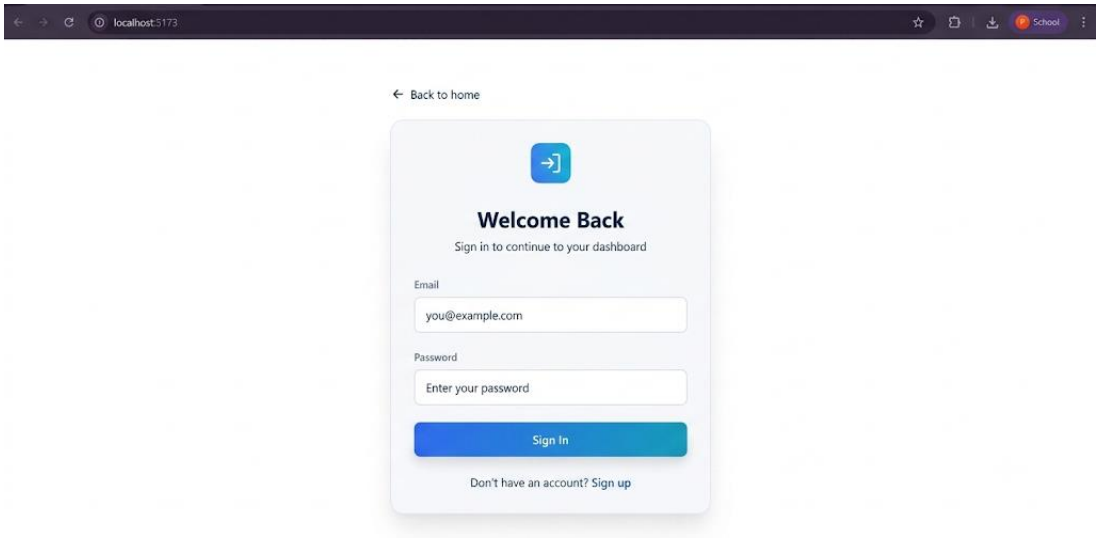


Figure 3. Login page of the system.

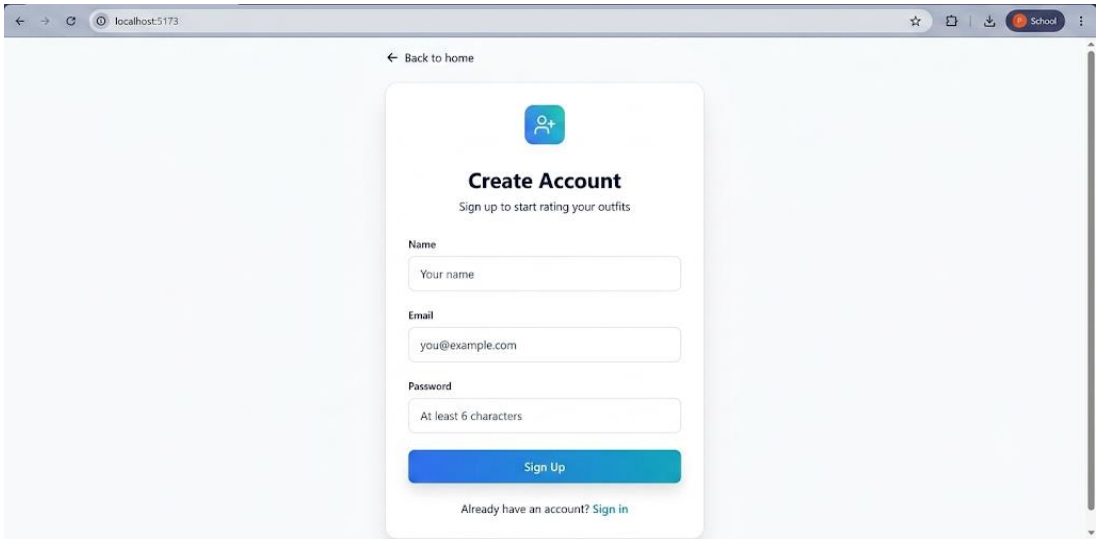


Figure 4. Sign-up page of the system.

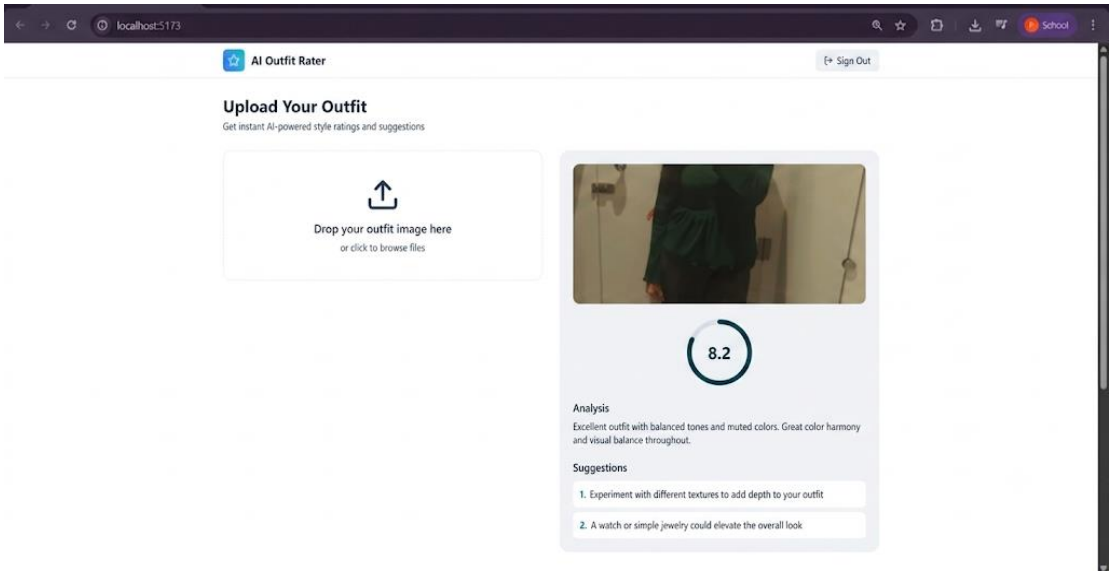


Figure 5. Dashboard showing outfit upload, rating, and suggestions.

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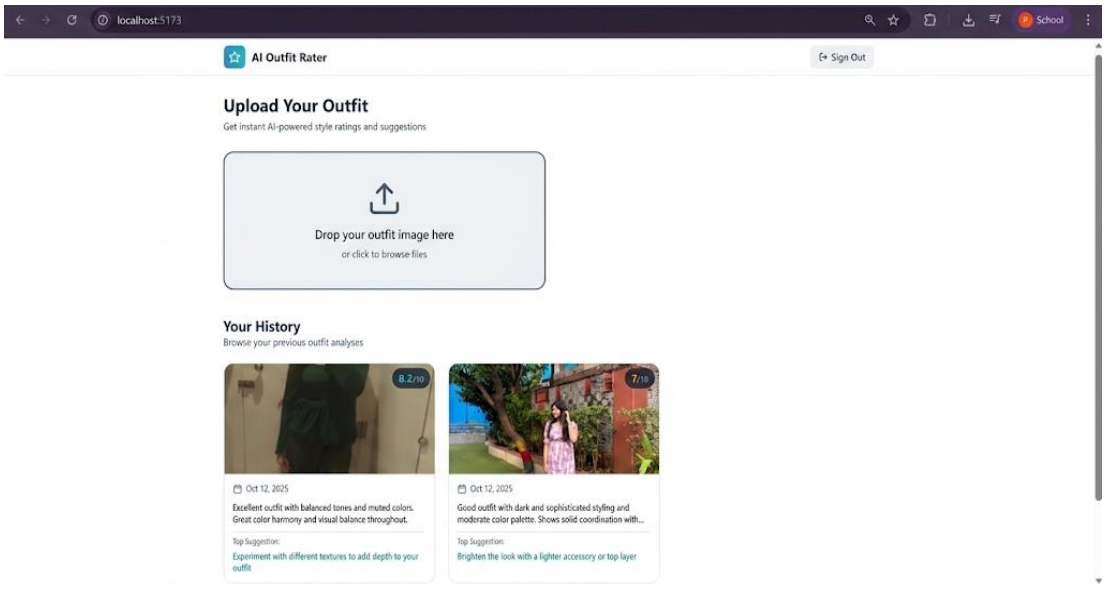


Figure 6. User outfit history page.

DISCUSSION

The evaluation results confirm that the AI-based outfit rating and suggestion system successfully delivers its core objective of providing holistic, explainable, and actionable fashion guidance to users. The hybrid scoring approach, which combines rule-based fashion knowledge with machine learning predictions, produces ratings that closely correspond to expert human assessments, thereby validating the technical design choices made in the methodology.

The high actionability rating (90%) reported by users demonstrates that the NLP-generated feedback is both clear and practically applicable, addressing a fundamental limitation of existing systems that provide classification outputs without meaningful guidance [11, 16]. The observed increase in user confidence (75%) and willingness to experiment with new styles (60%) indicates that the system has a measurable positive effect on users' relationship with personal fashion.

The system distinguishes itself from prior work [1, 2] through its combination of: (a) holistic outfit-level analysis rather than single-item classification, (b) numerical rating accompanied by descriptive, narrative feedback, (c) a hybrid scoring mechanism integrating domain rules with learned patterns, and (d) a secure, responsive web interface with persistent outfit history tracking.

The current implementation acknowledges several performance-dependency issues. The image quality, background complexity, and lighting conditions significantly influenced the accuracy of clothing detection and feature extraction. The system performed optimally on images with clear backgrounds and adequate lighting, and degraded performance was observed under challenging photographic conditions. These observations align with the findings reported in the related literature [9, 10] and point to concrete directions for future improvement.

LIMITATIONS

The AI-based outfit rating and suggestion system, while demonstrating strong performance across core evaluation metrics, is subject to several important limitations that contextualize its current capabilities.

First, the system currently supports only static image inputs and does not offer real-time video-based feedback, which limits its utility compared with what a live stylist or augmented reality application could provide. Second, image quality is a significant determinant of system performance; photographs captured under poor lighting, with cluttered backgrounds, or at unusual camera angles can degrade clothing detection accuracy and reliability.

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Third, the AI models were trained on a relatively small and potentially non-representative dataset, which may limit the system's ability to generalize across diverse cultural, regional, seasonal, and body-type-specific fashion contexts. Fourth, the system operates exclusively in a cloud-connected environment, which requires a stable internet connection. High-resolution images or complex multi-garment outfits may increase the processing latency.

Finally, the system cannot fully replicate the nuanced stylistic judgement of an experienced human stylist, particularly with respect to aspects such as fabric texture assessment, trend relevance evaluation, layering analysis, and occasion-specific appropriateness, which remain challenging to encode in current AI models.

CONCLUSION AND FUTURE SCOPE

The AI-based outfit rating and suggestion system represents a significant advancement in the application of artificial intelligence to personalized fashion guidance. By integrating computer vision-based clothing detection, a hybrid rule-and-machine-learning scoring engine, and NLP-driven feedback generation within a secure, responsive web platform, the system delivers comprehensive outfit evaluations that closely align with expert human fashion judgements. The evaluation results demonstrated a mean rating precision of 8.2/10, an 87% color harmony alignment with professional stylists, and high levels of user-reported actionability and confidence. These outcomes confirm that AI cases can effectively bridge the gap between basic outfit identification and meaningful, personalized style advice accessible to all users, regardless of their fashion knowledge.

The limitations of the system, particularly its dependency on static images and controlled photographic conditions, and the constraints of its current training dataset, define clear priorities for future development. Planned enhancements include real-time video-based outfit analysis, augmented reality virtual try-on capabilities, and expanded training datasets incorporating diverse cultural, seasonal, and body-type-specific fashion styles to improve inclusivity and accuracy.

Additional future developments include integration with e-commerce platforms to enable direct purchase links for recommended garments, offline functionality for use without internet connectivity, gamification elements such as style badges and achievement scores to increase user engagement, and more personalized recommendation models that adapt to individual user preferences over time. Through these advancements, the system is intended to evolve into a fully capable AI-powered virtual personal stylist, providing intelligent and universally accessible fashion guidance on a large scale.

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