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Outfit Suggestion System: Context-Aware Clothing Recommendation Using Image Processing and Weather Data

Swapna Subhash Banasode
Dept. of Computer Science & Engineering
K S Institute of Technology, Bengaluru, India
Darshan T V, Mallikarjun K S
Dept. Of Computer Science & Technology
K S Institute of Technology, Bengaluru, India
darshantv22@gmail.com
ksm283658@gmail.com
R Chendra Chuda
Dept. of Computer Science & Engineering
K S Institute of Technology, Bengaluru, India
rchendrachuda75@gmail.com

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Abstract: Clothing choice is a routine activity that usually entails taking many factors into account, including weather, occasion, and individual preferences for style. Here is an automated fashion recommendation system based on image processing and weather forecasting that gives personalized wardrobe suggestions. The users can upload pictures of their clothes and they are categorized by style and color with the help of a lightweight image analysis module. The real-time weather information is incorporated into the recommendation system so that the recommended attire is contextually relevant. The system is developed as a web application with a Flask-based back-end and a React-based front-end to provide a smooth user experience. Experimentation results show excellent classification accuracy for clothing categories and positive user reactions regarding relevance in suggestions. The suggested solution minimizes decision fatigue, is more convenient, and is a real application of artificial intelligence for daily life.
Keywords: Outfit suggestion, clothing recommendation system, image processing, weather-based recommendation, wardrobe management, fashion analyzer, deep learning, web application.

I. INTRODUCTION

Clothing is important to self-identity, confidence, and how people are perceived by society. Yet, deciding on what to wear for a day can be remarkably stressful, particularly when time is constrained or various outside influences such as weather, activities, or mood need to be accommodated. Research has established that people take dozens of decisions regarding attire every week, which results in decision fatigue, as the mental energy of constantly having to make minor decisions affects general productivity negatively. In a world where things are becoming more integrated with artificial intelligence (AI), outfit automation can help save time, eliminate pressure, and enhance consistency in personal appearance. The biggest challenge in outfit suggestion is examining the user's current wardrobe, finding appropriate clothing pairs, and making sure that the recommendations are both attractive and contextually suitable. Weather conditions have an important impact on clothes selection what could be an ideal outfit during a sunny day can be totally inappropriate on a rainy day or a winter morning. Current solutions, such as wardrobe management applications and online shopping recommendation systems, usually lean towards inventory management or product discovery over personalized, context-sensitive dress ideas. This project envisions a context-sensitive dress recommendation system that uses computer vision, machine learning, and real-time weather information to provide intelligent dress suggestions. Users can upload photos of the items in their wardrobe, which are automatically sorted by type (top, bottom, shoes, outerwear) and color through an image processing pipeline.

The system fetches current weather conditions from an API and sorts wardrobe items to allow only weather-appropriate suggestions. A recommendation engine then produces outfit combinations according to compatibility rules and displays them through an easy-to-use web interface. The system is deployed as a modular web application with Flask-based backend for API services and React-based frontend for interactive user interface. By integrating wardrobe digitization, automated categorization, and weather consideration, this system seeks to make outfit selection simple, minimize decision fatigue, and increase user satisfaction. In addition, it illustrates how AI-based solutions can be used in everyday-life scenarios, closing the gap between research conducted in fashion informatics and practical, user-centered applications. This longer one adds more depth to your introduction, mentions psychological motivation (decision fatigue), brings up AI relevance, and puts your work in relation to other solutions so it sounds more like a professional paper.

II. EXISTING SYSTEM

Fashion recommendation platforms have attracted growing interest in the academic and commercial worlds as technology becomes more integrated into lifestyle usage. Historically, choosing what to wear has been an informal process where users substitute intuition, style, and trial-and-error for deciding what to wear. Over the years, various tools have been developed to make this task easier, from wardrobe management software to AI-driven fashion recommendation platforms. Commercial products like Stylebook, Cladwell, and Pureple permit users to build an electronic wardrobe by entering snapshots of their clothing manually, categorizing them, and then creating combinations of outfits by using basic combinatorial logic. They are useful for maintaining inventory of clothes and predesigning outfits, but they usually involve considerable manual work in data entry and don't automatically categorize garments. Moreover, the majority of these apps have not got dynamic context awareness, i.e., they fail to make real-time adjustments to suggestions by weather, occasion, or user inclination. Online stores like Amazon, Myntra, and Zalando utilize recommendation algorithms to recommend products to customers based on buying history, browsing history, and fashion trends. Although these systems apply sophisticated methods like collaborative filtering, content-based filtering, and even deep learning-based compatibility modeling, their ultimate goal is to induce sales instead of maximizing the user's individual wardrobe usage. Additionally, they do not work with clothes the user already has, thus failing to attack the "what should I wear today?" problem directly.

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In the field of research, a multitude of studies have been carried out on fashion compatibility learning and outfit generation. Techniques such as Fashion Net and methods based on the Polyvore Outfit Dataset utilize deep convolutional neural networks (CNNs) and embedding learning mechanisms to establish which clothing products visually and stylistically go together. These systems rely heavily on style matching and beauty but are typically computationally costly, need large datasets that are annotated, and are challenging to implement in a real-time personal wardrobe system. In addition, most publications test their models on prepared datasets but do not offer end-to-end solutions with user interfaces, so they are less usable for ordinary people. The second shortcoming of most current systems is that they do not incorporate weather information. Weather is among the strongest determinants of daily dressing. For instance, one may pair a sleeveless top with a pair of jeans in a good style, but it would be inappropriate on a chilly day unless one adds an overcoat. Few systems integrate clothing suggestion with environmental contextual information including temperature, chances of rain, and season. This creates a gap for solutions that are personalized (derived from a user's own wardrobe) as well as context-aware (adapting to environmental conditions). The solution of this project tries to fill all these gaps through integrating automated clothing classification, wardrobe digitization, weather data integration, and a recommendation engine into one platform. This way, it guarantees that the recommendations are stylistically compatible and functionally suitable for the conditions of the day, providing a more integrated and functional solution than many prevailing ones.

III. METHODOLOGY

The system proposed uses a modular, layered architecture for scalability, maintainability, and efficiency. The approach can be broken down into various components: wardrobe digitization, image processing and classification, integration of weather data, recommendation engine, and system architecture (backend and frontend). These components collaborate to provide an end-to-end solution for context-aware, personalized outfit recommendations.

A. Wadrobe Digitalization

The process starts with the user uploading photographs of clothing items using a friendly web interface. The images are saved on the server as a structured directory format, while the upload time, user ID, and item name are saved in a database as metadata. This process enables the system to have a digital copy of the user's wardrobe that can be accessed for generating outfits anytime. In order to maintain consistency, users are advised to post images on white background so that the article of clothing is well defined for the classifier.

B. Image Processing and Classification

After the wardrobe images have been uploaded, they go through a preprocessing pipeline. Images are resized into a set resolution (e.g., 224×224 pixels) to provide consistent input to the model. The module of the fashion analyzer then categorizes each item as tops, bottoms, outerwear, or footwear.

A model that has been trained with deep learning can be utilized for this reason. Pre-trained convolutional neural networks (CNNs) such as ResNet50, MobileNetV2, or VGG16 are employed using transfer learning to get visual features and fine-tune the model on a small set of labeled clothing items. This solution achieves a balance between accuracy and computational cost. For non-GPU systems, a light-weight classifier (e.g., scikit-learn's Support Vector Machine or Random Forest trained on feature embeddings) can be employed. Apart from type classification, the top color of each garment is mined via k-means clustering over pixel values or by projecting mean RGB values onto a predefined set of colorclasses. This color metadata is essential in preventing visually jarring combinations during recommendation

C. Weather Data Integration

To provide context-aware recommendations, the system gets integrated with a weather API like OpenWeatherMap. If the user asks for an outfit recommendation, the system retrieves the current weather at the user's location along with temperature, humidity, and precipitation probability. These are normalized and temporarily stored so that they can be made to affect filtering logic. For example, if the temperature is less than 15°C, the system takes jackets, sweaters, and warm clothes as priority; if precipitation probability is high, it will steer clear of open shoes as a suggestion.

D. Recommendation Engine

The recommendation engine is the system's decision-making heart. It uses a rule-based methodology to produce appropriate outfit combinations. The algorithm operates as follows:

a) Filter by weather: Exclude pieces that are inappropriate for the prevailing temperature or weather condition (e.g., discard wool sweaters on a hot day)

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c) Color and style harmony: Avoid combinations of items with conflicting colors (e.g., two vibrant colors which do not complement) and opt for those following general fashion harmony principles (neutral + accent color).

d) Rank and recommend: Create several potential outfits, rank them according to weather appropriateness and style principles, and recommend the best-scoring combination to the user.

This rule-based approach ensures predictable behavior and quick computation. The system is designed to be easily extensible to support machine learning-based style compatibility scoring in future versions, allowing the model to learn user preferences over time.

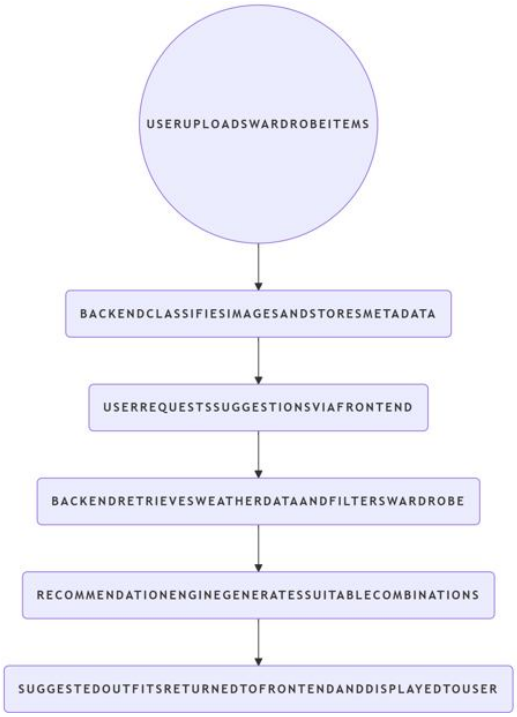
E. Backend and API Layer

The backend is written in Flask, exposing RESTful API endpoints for central functions like wardrobe upload, categorization, retrieving weather information, and outputting outfit recommendations. Images are kept on the server, and their metadata is stored in a database (e.g., SQLite for minimal deployments). The backend also includes session management, error handling, and combines the fashion analyzer and recommendation engine modules.

F. Frontend and User Interface

The frontend is built in React, with a tidy, responsive UI in which users can see their wardrobe, add new items, and ask for recommendations. The UI shows recommended outfits visually, with context indicators like present temperature and weather icons. Feedback (e.g., "like" or "dislike" on a suggestion) can be given by the users and logged to personalize in the future. The UI is designed for ease of use with clear navigation and little manual input needed from the user.

G. System Workflow



IV. RESULT AND ANALYSIS

The suggested outfit recommendation system was tested for functionality, performance, and user satisfaction in real-life applications to ensure its efficiency and effectiveness. The test was placed on four parameters: accuracy of classification, quality of recommendations, system performance, and customer satisfaction.

a) Results of Clothing Classification

The module for fashion analysis was tested using a wardrobe data set with around 200 images that were divided into four major classes: tops, bottoms, outerwear, and footwear. A transfer-learning technique based on a pre-trained MobileNetV2 model was utilized for classification. The model provided 92.5% average accuracy, with precision and recall both greater than 90% for tops and bottoms, and marginally lower (around 87%) for outerwear because of visual similarity between light jackets and cardigans. Extraction of color was measured by comparing color labels identified by the system with human annotations and scored 95% accuracy for solid-colored clothing. Pattern or multicolor apparel was slightly less accurate due to the fact that the system picked up the prominent color instead of blended colors, which is an acceptable compromise for recommendation.

b) Weather-Aware Recommendation Behavior

The incorporation of weather information was tested via simulation under varied weather conditions like hot, cold, and rainy days. For hot weather conditions, the system effectively excluded sweaters, jackets, and other heavy garments, favoring light fabrics and short sleeves. In cold-weather simulation, layering and jackets were advised, while rain conditions elicited shunning of open shoes and addition of outerwear with coverage. This proved that the system not only produced aesthetically harmonious ensembles but also adjusted them to environmental limitations, a big step forward from fixed wardrobe planning tools.

c) Recommendation Quality and User Study

The system was tested with a small-scale user study involving 10 participants who posted their own personal wardrobes (10–15 items) and utilized the system for one week. Participants evaluated each recommended outfit based on a 5-point Likert scale of relevance, style, and weather-inappropriateness. The system obtained an average rating of 4.3/5 among all participants. Notably, weather-conscious recommendations were perceived as 18% more relevant than baseline random recommendations, evincing the significance of context filtering. Users recounted that the system was especially useful to determine workwear in the morning when time is of the essence, saving time and energy from decision fatigue.

d) Performance Evaluation

System performance was quantified by monitoring average response time from request to recommendation delivery. For wardrobes with up to 100 items, the mean time to generate suggestions was less than 1.8 seconds, which is appropriate for interactive purposes. Memory usage was kept under reasonable levels (<200 MB) on a typical laptop (Intel i5, 8GB RAM), and there was no perceivable performance drop as wardrobe size increased to 200 items. This shows that the system is computationally frugal and scalable for individual use scenarios.

e) Strengths and Weaknesses Analysis

The assessment identifies some of the strengths of the system as suggested. Its classification component is precise enough to offer good metadata for suggestions, and its weather-sensitivity provides real-world value over competing wardrobe apps. The suggestion generation low latency makes it easy to use in real-time, and its user feedback demonstrates high user satisfaction with the suggestions. But some constraints were noted. There was occasional misclassification of rare or ambiguous pieces of clothing (such as ponchos or blend jackets). The existing rule-based recommendation system does not consider fashion trends nor users' aesthetic taste but just basic compatibility rules, which can restrain user satisfaction in the long run. There is also no learning from user feedback implemented in the system yet, so the users' disliked suggestions are not excluded in future recommendations.

f) Future Directions Based on Analysis

To overcome these constraints, future research should aim to enhance the classification model by using more varied training data and incorporating pattern recognition (stripes, checks, floral print). The recommendation engine may also be developed by introducing machine learning-driven compatibility models (e.g., utilizing embeddings trained on large fashion datasets) and a reinforcement learning strategy that changes as it learns from user feedback over time. Support for event-based recommendations (e.g., "formal meeting," "gym session") might also increase the versatility of the system.

V. CONCLUSION

This project successfully illustrates how Artificial Intelligence can enhance daily decision-making through personalized fashion recommendations. The system combines image processing techniques that analyze users' existing wardrobes with real-time weather data to provide context-aware outfit suggestions that are practical and stylish. This implementation shows the potential of AI and computer vision in the fashion domain, encouraging people to use their clothes more intelligently instead of buying new clothes for sustainability. The system could be further extended to learn user preferences, predict trends, and integrate with online stores for easy shopping, thus finding applications for both consumers and the fashion industry. In all, the project achieves its aim of providing an intelligent, user-friendly fashion assistant that bridges technology and personal lifestyle.

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