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Cody Recommendation System Using Deep Learning and User Preferences

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Abstract

As AI technology is recently introduced into various fields, it is being applied to the fashion field. This paper proposes a system for recommending cody clothes suitable for a user's selected clothes. The proposed system consists of user app, cody recommendation module, and server interworking of each module and managing database data. Cody recommendation system classifies clothing images into 80 categories composed of feature combinations, selects multiple representative reference images for each category, and selects 3 full body cordy images for each representative reference image. Cody images of the representative reference image were determined by analyzing the user's preference using Google survey app. The proposed algorithm classifies categories the clothing image selected by the user into a category, recognizes the most similar image among the classification category reference images, and transmits the linked cody images to the user's app. The proposed system uses the ResNet-50 model to categorize the input image and measures similarity using ORB and HOG features to select a reference image in the category. We test the proposed algorithm in the Android app, and the result shows that the recommended system runs well.

Keywords: *deep-learning, Fashion, Cody Recommendation, User Preferences*

1. INTRODUCTION

Recent rapid advances in IT technology have led to the development of telecommunications and the Internet and the popularization of smart devices, enabling online services to be used in real time without time and space constraints. In addition, a large amount of data in various formats is rapidly generated, and users are searching for and using related contents in various fields on the web and pursuing convenience of life. However, the greater the information, the more difficult it is to find information that is personally relevant [1]. Accordingly, users need a recommendation system that can efficiently filter data and provide the most relevant content. Examples of recommendation systems include Amazon.com's product recommendation system[2], Netflix's movie recommendation system[3], news articles [4], and Twitter [5]. In addition, in the apparel industry, a recommendation system is applied to recommend products that meet consumers' preferences. Recently, a lot of researches are being made to improve the recommendation performance by combining deep learning. Deep learning is a technology that shows outstanding performance in various fields such as image, video, natural language processing, speech recognition, etc., and can effectively process complex interaction of input data

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and predict the desired value. Stitchpix, which offers clothes for $ 20, attracted those who had trouble shopping, and 2 million members joined Stitchpix [6]. Shinsegae Department Store's online shopping mall, Shinsegae Mall, introduced a "Sseug lens" service that enables product search by image [7]. Sseug Lens is a deep learning-based image analysis technology developed by Shinsegae. It is a service that provides shopping information. In addition, a method of rapidly measuring a consumer's body size for use in a clothing store and recommending clothing in the clothing store according to the consumer's body size and taste is proposed [8].

The system that recommends the combination of deep learning and consumer's preferences recommends product selection based on shopping information or click information. Many researches recommend clothing related to the top and bottom selected by the consumer, but the system of recommending and coordinating matching clothes is not well studied. Therefore, in this paper, we propose a coordination recommendation system that recommends appropriate clothing when the user provides a top or bottom photo.

2. CONVENTIONAL METHOD

In the fashion field, personalized fashion style recommendation services are put into practical use as algorithms for matching different types of databases are developed, such as product data in design and customer data in marketing. In general, the recommendation service is collaborative filtering (CF) that recommends an appropriate fashion style by statistical analysis of the user's historical data, or content-based filtering (CBF) that recommends the appropriate one based on features such as registered form or color. However, in recent years, a combination of the two or a combination of new technologies has been applied, and more advanced personalized recommendation services have become possible [9]. Recently, there has been a change in the existing online shopping structure that could not be directly observed, experienced, or purchased through the introduction of deep learning technology, virtual reality, and augmented reality technology, which show excellent performance in image processing.

3. CODY RECOMMENDATION SYSTEM USING DEEP LEARNING AND USER PREFERENCES

In this paper, an algorithm to recommend a cody clothes reflecting user preference is proposed. Deep Learning algorithm and image processing technique are applied to select appropriate costumes. The proposed system consists of three parts of the user app, code recommendation module and the server that communicates the user app and cody recommendation module .

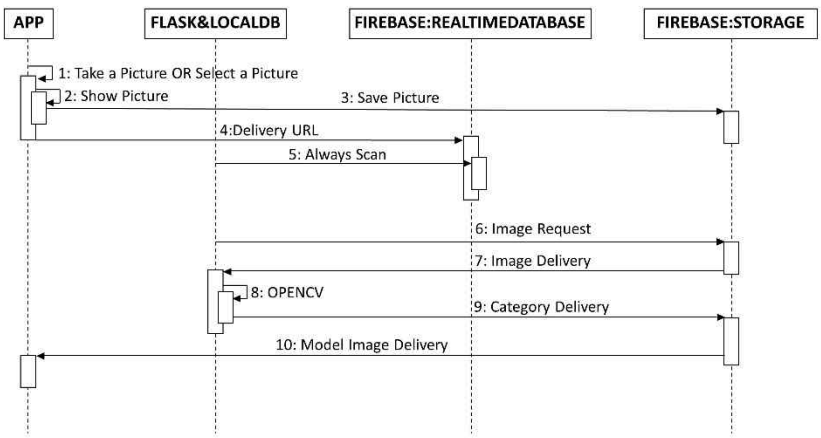


Figure 1. flow of the proposed algorithm

Firstly, the proposed algorithm sends a image from the app to the server, where the user either takes pictures or chooses one among already saved them. Then the server receives the transmitted picture and sends the received images to the cody-recommended module. The cody-recommended module classifies the image into a class, selects appropriate cody costumes using images of classified classe, and transmits labels of the cody costumes to the server. The server finds the transmitted labels in the database, sends the matching cody images to the app, and the transmitted image is displayed in the app. Figure 1 shows the whole process of processing.

3.1 The app for users.

The user app runs on the Android platform and consists of logins, camera-captured costume photos, costume photos stored in the gallery, selection and transmission of clothing images for cody and recommended cody clothing displays.

Figure 2 shows the entire configuration of the app, and when the app is first launched, the logo screen is loaded and then the login screen is displayed. In this paper, Firebase is used as a server. Login is using Google Login through the authentication service of Firebase. Once logged in, user can take a camera to save user's costume to the gallery, and user can import your own images by selecting the pictures that exist in the gallery. User select one of the imported images to send to the server, and the image sent to the server is processed and the cody image is output on the screen.

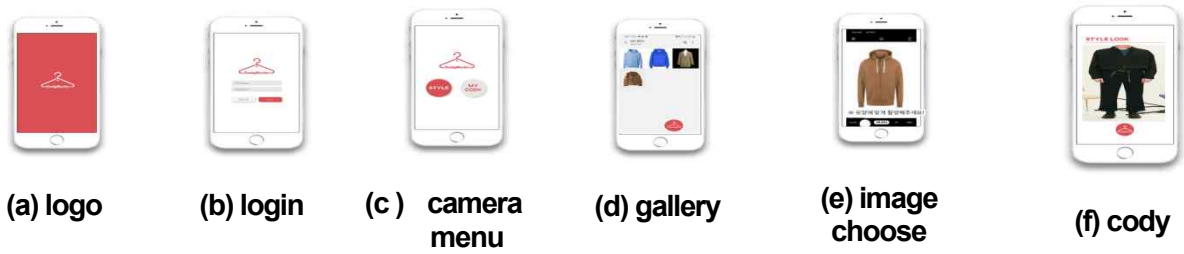


Figure 2. App Configuration Screen

3.2 Server and DB Configuration

In this paper, two servers are configured for interlinking mobile app and cody recommendation module. First, the server used Firebase as the server for data management and interlinking user app. And the server for code recommendation was implemented as a flask so that image processing using Python, Deep Learning, and OpenCV could be executed.

Firebase is a backend as a service (BaaS) that provides the functionality needed for web and mobile development, which helps you focus on front-end development without designing and implementing servers separately [10]. The proposed system uses the Firebase server to authenticate users and stores photos sent by authenticated users on the app in storage and databases. The actual image is stored in a folder in the storage and the database stores the location (URL) of the image. It also stores cody-recommended images in the repository and stores URLs in the database.

Flask is a lightweight web application framework [11] powered by Python, so it is used to configure API servers with Python. These characteristics are appropriate for performing deep learning models and openCV functions for image processing. In this paper, flask receives the images sent to Firebase from user app and uses Python, Deep Learning model and openCV to determine recommended images and sends URL of recommended images to FireBase

3.3. Deep Learning and Video Processing for Cody Recommendation

In order to detect the cody-recommended images, the algorithm goes through two steps. First of all, the clothing category is defined using the pre-trained deep learning model. The Deep Learning model for the classification of costume categories consists of the Keras' resnet-50 using training data collected on the web, and the costume categories were divided into 80 classes based on top/bottom, shape, color and texture.

Then it executes detailed classification within the category using OpenCV and determine recommended images. There are various costumes in one category that are similar in color and shape but not completely identical. We set the classified image into a similar image among multiple representative reference images for each category and then three cody images suitable for the classified images. For example, if a yellow plain shirt is selected, three full body images (from neck to foot or ankle) with pants matching the yellow plain shirt are recommended. To set the classified image into a similar image among reference images within each category, the features of the input image and each representative image are extracted and the most similar images are selected as representative images of the original image by comparing the similarities between the features. In this paper, the features of images were extracted using ORB and HOG[12] and the features were compared using the Euclidean distance to measure the similarity. Figure 3 shows an algorithm for detecting cody-recommended images.

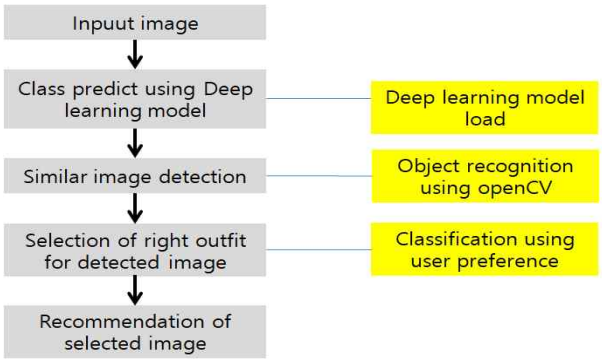
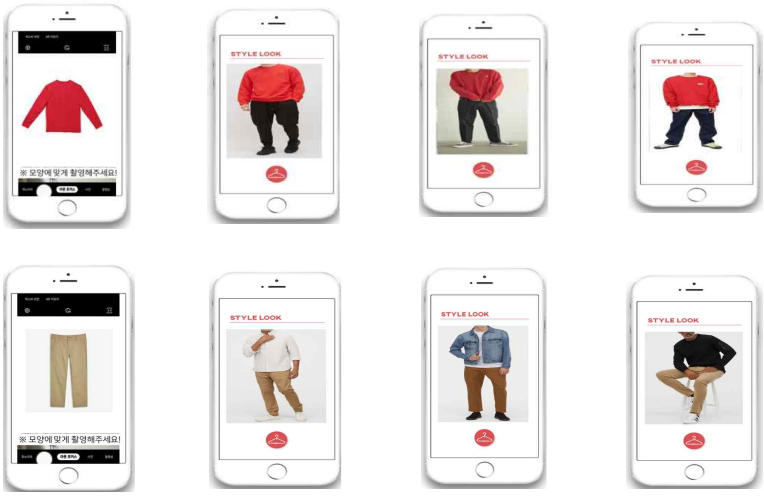


Figure 3. flowchart of fashion recommendation

In order to set recommended images of representative images in category, we use a Google survey app to examine the preferences of users'. The survey was for late 20s and early 30s, and five relevant cody images were sampled for each representative image to examine user preferences. When accessing the survey site, the user should select the sex, and then the five full body code images wearing input images and input images is displayed. User selects the three images that are considered the best cody among the code images. Ten representative images per a person were surveyed and 10 to 15 people per image were collected. The results of the survey were analyzed and the cody images of the users were selected and set the images into each representative image.

4. EXPERIMENT AND RESULTS ANALYSIS

After implementing the proposed system, the app was running on the Android phone to test whether it was working or not. Figure 4 shows the proposed algorithm is running in Android app. The proposed method tested VGGNet16, VGGNet19, and ResNet-50 with the same conditions as batch size, learning rate, loss function, and epoch in order to find appropriate deep learning models for predicting classes of input images, and the performance of the ResNet-50 was the best. The training condition is selected by the best performance after we measured resNet-50'performance under different conditions. The RESNet-50 model was trained using data multiplication and the batch size was 32, the step for epoch 200, the epoch of 100, the learning rate of 1e-4.



(a) user input **(b) recommended codies**

Figure 4 Result of the proposed algorithm

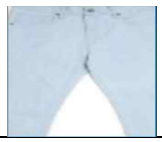
	input	Ref. 1	Ref. 2
image			
feature	Input HoG Des= [[0.03685179] [0.03868821] [0.06300039] ... [0.12064485] [0.13861021] [0.15469941]]	Ref1 HoG Des= [[0.0040775] [0.00177513] [0.01083716] ... [0.16231175] [0.19005907] [0.30371127]]	Ref2 HoG Des= [[0.4737858] [0.29338446] [0.04393201] ... [0.01843873] [0.10595284] [0.5006801]]
difference		66.89447784423828	100.62296295166016
	input	Ref. 1	Ref. 2
image			
feature	Input HoG Des= [[0.04493515] [0.00864695] [0.03071586] ... [0.04556425] [0.10693247] [0.40125933]]	Ref1 HoG Des= [[0.31129968] [0.21218835] [0.07449016] ... [0.0033533] [0.] [0.17101948]]	Ref2 HoG Des= [[0.24444382] [0.17766775] [0.08285889] ... [0.00247972] [0.02260633] [0.3330757]]
difference		82.4267578125	89.8631820678711

Figure 5. Feature images and similarity results of input image and references images

Figure 5 shows the features extraction result and the similarity measurement of the reference images within the category and input image. The result shows the proposed algorithm works well.

5. CONCLUSION

This paper proposes a system to recommend the user to Cody outfits for selected image. The proposed system consisted of user's app, servers to interwork with apps and recommended image processing servers and cody costumes recommended module. Firebase was used as a server for interconnecting modules and Flask was used as an image processing server for selecting recommended images. To recommend cody images, deep learning model of ResNet-50 and the ORB and HOG is used. The proposed method was tested on Android phones and the various experimental results demonstrated that the proposed method algorithm performs the cody recommendation service well.

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