

Based on machine learning for personalized skin care products recommendation engine

Hsiao-hui Li
Bachelor's Degree Program in Chain
Store Management
Tainan University of Technology
Tainan, Taiwan
xiasohui@gmail.com

Yuan-Hsun Liao*
Master Program of Digital Innovation
Tunghai University
Taichung, Taiwan
yuanhsunliao@gmail.com

Yen-nun Huang
Research Center for Information
Technology Innovation
Academia Sinica
Taipei, Taiwan
yennunhuang@gmail.com

Po-Jen Cheng
Department of Computer Science and
Information Engineering
National Chung Cheng University
Chiayi, Taiwan
design0923@gmail.com

Abstract—With the economic development and the aging trend, the use of cosmetic products has expanded rapidly. In an ever-expanding skin care market, facial skin care product was the most popular product of skin care product. However, thousands of skin care products are available in the market. With endless options, shoppers are confronted confused and tired. Because everyone's skin condition is not the same, using unsuitable skin care products can damage the skin. Frequent problems with face skin are wrinkles, spots, acne vulgaris, pores, etc. The causes of facial lines, such as dryness, facial expressions, aging, etc., are cause different shades and different types of wrinkles. Therefore, it is very important to know your skin quality and use skin care products correctly. According to the application of different levels of image processing, it can be divided into image classification, positioning, object detection and object segmentation in the field of image vision. This paper will focus on the application of machine learning and deep learning algorithm development on human face and skin intelligence recommendation platform. That uses YOLOv4's novel object recognition algorithm to detect key features in face images, and intercept sub-images of regions of interest (ROI) as input information for multi-label models. Each sub-image detects the defective part through the YOLOv4 identifier of the second layer, and calculates the ratio of the pixel area of the local block to the main body to evaluate the correlation between feature parts and degree to establish a reference for the optimization of subsequent multi-label model. The skin condition classification uses the image processing algorithm to preprocess automatically remove, reduce noise, enhance, normalize and extract features to obtain the feature vectors of the sub-images for training the multi-label classification model. The prediction results of machine learning can provide suitable maintenance knowledge and product recommendations for users to recommend the suitable skin care products and maintenance ingredients for the user's skin condition.

Keywords—Machine Learnin, YOLOv4, Skin Care, Recommendation Engine

I. INTRODUCTION

With the economic development and the aging trend, the use of cosmetic products has expanded rapidly. And, the global cosmetic products market has gradually become larger. It is very difficult to choose the one that suits you among many cosmetics. Because everyone's skin condition is the same, using unsuitable skin care products can damage the skin. Because everyone's skin condition is different, the use of unsuitable skin care products can damage the skin [1]. And,

some people will be allergic to certain cosmetic ingredients to cause redness, itching and other reactions. Frequent problems with face skin are wrinkles, spots, acne vulgaris, pores, etc., as Fig. 1. The causes of facial lines, such as dryness, facial expressions, aging, etc., are cause different shades and different types of wrinkles [2]. The appearance of wrinkles is a natural phenomenon on the skin. On the other hand, people's health, living habits, and sanitary conditions all affect the formation, increase and decrease of wrinkles. The formation of spots may be affected by factors such as exposure to sunlight, age growth, and physical fitness. Common spots include age spots, sun spots, freckles or deeper dermal layers of cheekbone mother spots, Ota mother spots, etc. [3]. There are many factors that can cause acne vulgaris, such as stress, staying up late, lack of sleep, diet, hormonal changes, improper use of maintenance products or cosmetics, sultry sweating, dirty environment, certain oral medicines, etc. [4]. Therefore, it is very important to know your skin quality and use skin care products correctly.



Fig. 1. Frequent problems with face skin as (a)acne vulgaris; (b)spots; (c)wrinkles.

II. FEATURE OF FACE SKIN

Human's facial skin is to defend against various external stimuli such as dryness, sunlight, ultraviolet rays and various chemical stimuli and damage. The most common features of facial skin are wrinkles, spots, acne vulgaris, and pores [5].

Wrinkles: Wrinkles is a phenomenon of human aging. This phenomenon will be divided into two categories according to the degree of depth. The shallower wrinkles are the lines formed by the serious loss of epidermal moisture. The deeper wrinkles are the lines formed by the loss of collagen and elastin fibers in the dermis. Wrinkles are also formed by facial expressions and aging[6].

Acne vulgaris: Acne vulgaris is a diffuse inflammation of pilosebaceous follicles. Most of them are caused by excessive secretion of puberty hormones and stimulation of sebaceous glands to make blocked of pilosebaceous orifice[7].

Most of the medicinal ointments used to treat acne contain the following ingredients:

- Benzoyl Peroxide
- Corticosteroids
- Tretinoin
- Clindamycin
- Benzoyl peroxide

The anti-acne ingredients generally used in skin care products include the following ingredients.

- Sulfur
- Salicylic Acid

Spots: Spots are generally produced by the ultraviolet rays of the sun and genetics. Spots are deepened or increased by exposure to sunlight [8]. Before melanin synthesis, tyrosinase transcription and tretinoin can be used to lighten spots. Tyrosinase degradation, linoleic acid, and α -linolenic acid can be used after melanin synthesis. The inhibition of melanosome transfer can use a serine protease inhibitor, neoglycoproteins, soybean/milk extracts, and niacinamide.

The ingredient list of related whitening effects is shown in the following table 1.

TABLE I. TABLE TYPE STYLES

TABLE II. INGREDIENT	Limited Quantity	Usage
5,5'-Dipropyl-Biphenyl-2,2'-diol	0.50%	Inhibit melanin formation, Skin whitening
Cetyl Tranexamate HCl	3%	Inhibit melanin formation, Skin whitening
Tranexamic Acid	2.0-3.0%	Inhibit melanin formation
Potassium Methoxysalicylate	1.0-3.0%	Inhibit melanin formation, Skin whitening
3-O-Ethyl Ascorbic Acid	1.0-2.0%	Inhibit melanin formation, Skin whitening
Ascorbyl Tetraisopalmitate	3.0%	Inhibit melanin formation
Mangesium Phosphate Ascorbyl	3.0%	Skin whitening
Kojic acid	2.0%	Skin whitening
Ascorbyl Glucoside	2.0%	Skin whitening
Arbutin	7.0%	Skin whitening
Sodium Ascorbyl Phosphate	3.0%	Skin whitening
Ellagic Acid	0.50%	Skin whitening
Chamomile ET	0.50	Prevent spots

Reference: Taiwan Food and Drug Administration [9]

III. METHODS

According to the application of different levels of image processing, it can be divided into image classification, positioning, object detection and object segmentation in the field of image vision [10]. In practical applications, it is often

discussed that object detection is the primary processing object. Image classification and positioning is a function of additional positioning in the application. The position of the four coordinate points of the regression prediction detection frame after extracting features by convolution to achieve the classification image positioning. The algorithm of YOLO can be regarded as a regression problem. Therefore, this paper will focus on the application of machine learning and deep learning algorithm development on human face and skin intelligence recommendation platform. That uses YOLOv4's novel object recognition algorithm to detect key features in face images, and intercept sub-images of regions of interest (ROI) as input information for multi-label models [11]. Each sub-image detects the defective part through the YOLOv4 identifier of the second layer, and calculates the ratio of the pixel area of the local block to the main body to evaluate the correlation between feature parts and degree to establish a reference for the optimization of subsequent multi-label model. The skin condition classification uses the image processing algorithm to preprocess automatically remove, reduce noise, enhance, normalize and extract features to obtain the feature vectors of the sub-images for training the multi-label classification model. The prediction results of machine learning can provide suitable maintenance knowledge and product recommendations for users to recommend the suitable skin care products and maintenance ingredients for the user's skin condition.

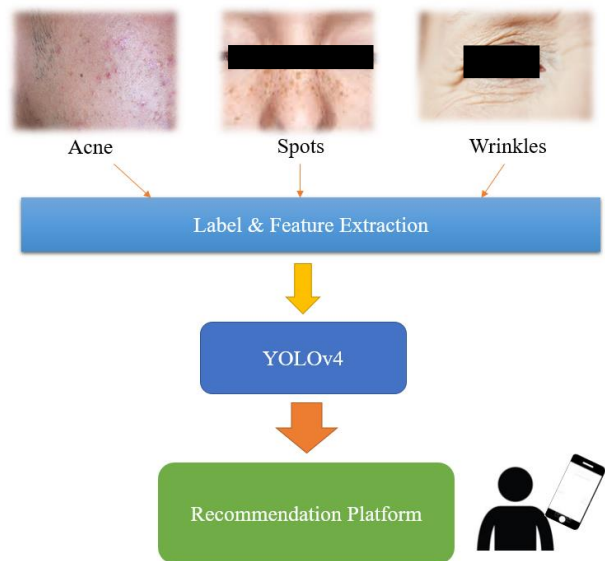


Fig. 2. Design structure.

IV. CONCLUSION

This research mainly uses YOLOv4 for facial skin recognition. The machine learning algorithm can quickly and accurately identify the user's skin condition. And then, that transform the prediction result to the recommendation platform to analyze the skin care product suitable for the user. As a result, users can better understand their skin quality and use more suitable products to avoid skin damage and damage caused by using the wrong product.

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