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Evaluation of Skin Psoriasis Classification Using Convolutional Neural Network with a Potential for Ayurvedic Treatment

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Abstract:

This is due to the fact that humans can only see and study diseases on the skin's surface with their unaided eyes, which has limitations. For instance, human vision is not very accurate, reproducible, or quantifiable when it comes to gathering image data. Since skin and plaque are the most frequent skin conditions caused by psoriasis, This study uses convolutional neural networks to assess how well psoriatic skin disorders may be categorized. DermNet NZ, the International Psoriasis Council (IPC), and the Psoriasis Image Library contributed 187 images in total, 105 of which were for skin psoriasis and 82 of which were for plaque psoriasis.

In order to extract information and analyze the classification of psoriasis skin illness, convolutional neural networks, or CNNs, are used. With accuracy rates of 82.9% and 72.4% for plaque and skin psoriasis, respectively, this study demonstrated the promising application of CNN.

Keywords—**Psoriasis detection, convolutional neural network, Generative Adversarial Network, Ensemble model**

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1. INTRODUCTION

The largest organ in the human body is the skin. Skin has an estimated surface area of two square yards and weighs between six and nine pounds. The skin divides the body's inside. Additionally, the skin regulates body temperature and offers defense against germs, viruses, allergies, and fungal infections [1]. Since many people disregard and care for their personal skin cleanliness, a large number of people suffer from skin diseases caused by germs or viruses [1]. Numerous skin conditions exist, including psoriasis, ringworm, alopecia, and eczema [2].

These illnesses all strike without warning. This also holds true for psoriasis, which is a condition that many Malaysians are likely to have. Because there are so many different types of skin illnesses, including ringworm, eczema, psoriasis, and rosacea, people in Malaysia find it difficult to identify them. Red scaling papules that create a round-to-oval plaque and are visible from the surrounding normal skin are the hallmark of psoriasis [3].

Most often found on the scalp, elbows, knees, and lower back, psoriasis can spread to other parts of the body and cause a variety of harmful skin conditions that eventually impair a person's physical appearance. Psoriasis causes the epidermal layer to thicken, blood vessels to enlarge, and a large number of immune cells to infiltrate the dermis and frequently into the epidermal compartments [4]. Plaque, Skin, Inverse, Pustular, and Erythrodermic are the several types of psoriasis skin disease, each with unique characteristics [5–6].

The most prevalent kind of psoriasis is plaque psoriasis [7]. According to the Dermatological Society of Malaysia, between 2 and 6 percent of people in Malaysia have psoriasis. Out of all the skin diseases, plaque psoriasis has the largest percentage (85.1%), making it the most prevalent and well-liked [7]. These days, a lot of skin conditions have similar symptoms, making it challenging for people to distinguish between different abnormalities. A number of medical image analysis applications and technologies, including image processing [8–14], fuzzy logic [15–16], machine learning [17], artificial neural networks [18], convolutional neural networks [19–26], and many more [27], have been demonstrated in prior research.A crippling skin condition that affects both physical and mental health is psoriasis. Clinical examination is crucial to its diagnosis, which frequently calls for specific dermatological knowledge. Delays in diagnosis, incorrect diagnoses, and eventually less-than-ideal therapy might result from this. By utilizing developments in artificial intelligence (AI), computer-aided diagnosis (CAD) systems present a viable path toward increasing diagnostic accessibility and accuracy.Image processing is the process of turning an image into a digital format for use in signal processing and other image research applications, such as the medical industry. Using specific operations on a picture that has been transformed into digital form, image processing has been utilized to extract valuable information. picture processing controls picture extraction, segmentation, and augmentation [17]. The process of improving a picture's appearance for human viewing or transforming it into a format more appropriate for machine processing is known as image enhancement [28]. Segmenting a picture into many parts is known as image segmentation. For example, segmenting and identifying an image of the human body or any other portion of an item, then combining the full Certain characteristics of an image, including color, can be used to determine the relationships between pixels in the segmented image. Deep Convolutional Neural Networks (CNN), also referred to as ConvNet, have gained a lot of popularity recently for feature learning and object classification. Because of the GPU's great performance, a network may be trained on enormous datasets to achieve superior results. One type of Artificial Neural Network (ANN) that is well-known for its exceptional strength in picture identification and classification is CNN [19–21]. However, because psoriasis and eczema share a similar appearance, it can be difficult to distinguish between the two conditions. Furthermore, getting an appropriate diagnosis the first time is typically exceedingly challenging.Ayurveda provides a comprehensive approach to psoriasis management that goes beyond traditional therapies. It emphasizes reestablishing the body's natural equilibrium through dietary changes, lifestyle adjustments, and herbal remedies. This study explores the possible benefits of combining Ayurvedic principles with AI-powered diagnosis for all-encompassing psoriasis treatment.

2. RESEARCH METHOD

In order to improve performance, this research aims to categorize and identify the types of skin diseases, including psoriasis and plaque. Data collection, pre-processing, processing (feature extraction and categorization of psoriasis skin illness), and post-processing (test and evaluation) are the four stages of this study. The suggested algorithm's process flow is depicted in Figure 1.

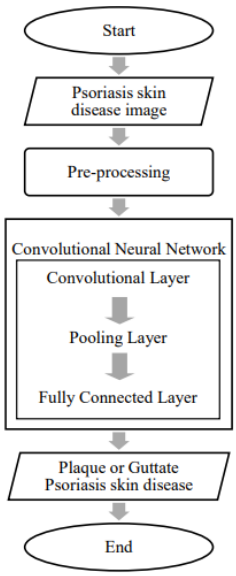

Figure 1. Flowchart of the proposed psoriasis classification

2.1 CNN-based Psoriasis Detection Enhanced by GAN Data Augmentation:

- **Data Acquisition and Preprocessing:** We will gather a dataset of dermatological photos, such as pictures of healthy skin and psoriasis lesions. Preprocessing techniques like scaling, normalization, and noise reduction will be applied to the photos. Data privacy and ethical considerations will receive careful attention.
- **CNN Architecture Selection and Training:** We will investigate many CNN architectures that have been pre-trained on ImageNet, such as ResNet, DenseNet, and EfficientNet. Transfer learning will be used to refine these models on the psoriasis dataset. To get the best performance, hyperparameter tweaking will be done.
- **GAN-based Data Augmentation:** Using lesion kind and disease severity as inputs, a CGAN will be trained to produce artificial psoriasis images. A thorough assessment of the generated images' diversity and realism will be conducted. To enhance CNN's capacity for generalization, these artificial images will be incorporated into the training dataset.
- The accuracy, precision, recall, F1-score, and AUC-ROC measures will be used to assess the CNN model's performance. Models trained with and without GAN-augmented data will be compared.

2.2 Image dataset

The Psoriasis picture Library, the International Psoriasis Council (IPC), and the DermNet NZ website have all provided psoriasis skin disease picture databases for download [30]. The two types of psoriasis that were discussed in this research were skin psoriasis and plaque psoriasis. A total of 187 photos of psoriasis are utilized as test photos, of which 105 are of skin psoriasis and 82 are of plaque psoriasis. Figure 2: Plaque and Skin Psoriasis Skin Disease Sample

(a) Plaque (b) Gutttate

Figure 2. Sample of psoriasis skin disease [30]

2.3 Pre-processing

The input image is a pre-processed image of plaque and skin psoriasis, which is shrunk to equalize all image datasets in a consistent data shape. To improve the accuracy of the disease classification, the original safe image of skin psoriasis and plaque is shrunk to 160 by 160 pixels. To enable and facilitate CNN's speedy feature extraction and classification, psoriasis photos are resized.

2.4 Convolutional neural network

One of the most effective deep learning techniques for picture identification and classification is the convolutional neural network (CNN). In Artificial Neural Networks, CNN is now completely categorical [21]. in order to improve performance by training a network on a huge dataset. The method's structure, which consists of a convolution layer, pooling layer, and fully linked layer, is comparable to the diagram displayed in Figure 3 [22].

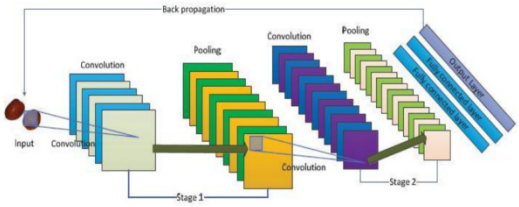

Figure 3. Basic structure of CNN

2.5 Convolutional layer

The basic component of CNN is the Convolutional layer (CL), which consists of shared characteristic weights and local connections [26]. This indicates that every channel passes through CL for a unique filter. The CL creates a 2D activation map of the kernel by convolving several trained kernels across the width and height of the input features in the

forward pass [20]. The input features are utilized to teach the CL the feature representations. The spatial relationship of the pixels is being preserved by CL [21]. For instance, the convolution sample in 4 was created using a 2x2 kernel [22].

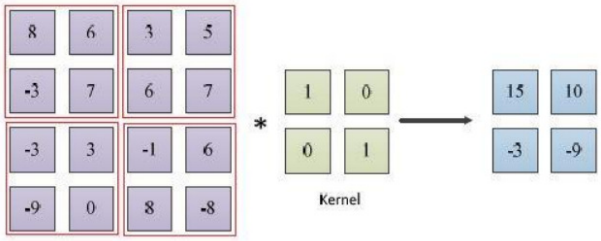

Figure 4. Convolution with 2x2 Kernel Sample Result

2.6 Pooling layer

Typically, two CL are separated by a pooling layer (PL). Sub-sampling, also known as PL, is a nonlinear compression of feature maps that undergo a nonlinear transformation, converting a collection of pixels (often 2x2 in size) to a single pixel [20]. The movement step of kernels determines the size of feature maps in PL [26]. One advantage of PL is that it can decrease the size of feature maps and increase the efficiency of feature extraction [22]. A detailed image is reduced in detail and does not require additional processing if certain features were already identified during the last folding procedure [20]. The two most popular pooling operations or methods are average pooling and maximum pooling [26].

Figure 5 [22] is an illustration of the max pooling procedure with a dimension of 2x2.

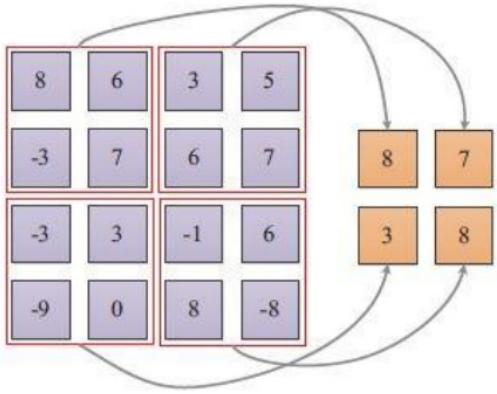

Figure 5. Max pooling with Size of 2x2

2.7 Fully connected layer

CNN classifiers usually consist of one or more Fully Connected Layers (FCL) [26]. Every node in an FCL has a direct connection to every other node in the preceding and subsequent layers [27]. New features are extracted from the image using the output of CL and PL procedures. FCL then uses features to classify the input image into distinct groups based on the training dataset [21]. FCL does not maintain spatial information [26].

Because it produces a well-performed probability distribution of the results, softmax regression is often employed. AlexNet is an eight-layer Convolution Neural Network; the final three layers are completely connected, the final layer is classified by softmax, and the first five layers are convolutions. The model suggests the dropout method to lessen the over-fitting issue and substitutes .

2.8 Test and evaluation

Assessing statistical classification in the field of machine learning is the aim of quantitative evaluation. The following True Positive (TP) and False Negative (FN) confusion matrix is used to validate the accuracy evaluation [10]. The following is the definition: TP, or true positive: to calculate the expected outcome of skin diseases like psoriasis and plaque as well as the actual, properly identified outcomes of these conditions. The following formula can be used to calculate the TP accuracy rate.

$$TP = (A/B) \times 100$$

where A is the number of anticipated images of skin psoriasis and plaque that are categorized as actual images of these conditions. B stands for the total number of images of skin psoriasis and plaque. FN, or false negative: to calculate the erroneous classification result of Plaque and Skin Psoriasis skin illness as the projected result of these conditions. The following formula can be used to calculate the FN accuracy rate.

$$FN = (A/B) \times 100$$

where A is the number of expected images of skin psoriasis and plaque that are not considered to be real images of these conditions. B stands for the total number of images of skin psoriasis and plaque.

Exploring Ayurvedic Principles for Psoriasis Management:

Review: To find pertinent Ayurvedic principles for treating psoriasis, a thorough analysis of Ayurvedic literature will be undertaken, including major works like the Charaka Samhita and Sushruta Samhita.

Identification of Key Ayurvedic Herbs and Therapies: We will identify important Ayurvedic herbs with anti-inflammatory, immunomodulatory, and skin-healing qualities based on the literature review. We will also look into certain Ayurvedic treatments like Virechana (therapeutic purgation) and Panchakarma (detoxification).

Potential Integration: We will investigate possible approaches to tailor Ayurvedic treatment according to CNN diagnosis. In accordance with Ayurvedic concepts of balancing Pitta and Kapha doshas, the CNN may, for example, determine the main lesion type, which could then guide the selection of particular herbs and therapies.

3. RESULTS AND ANALYSIS

The evaluation metrics and comparison between models trained with and without GAN-augmented data will be included in the findings of the CNN-based psoriasis detection model. Additionally, the performance of several CNN designs will be contrasted.

We will go into great depth about the results of the Ayurvedic literature research as well as the identified herbs and treatments. Based on both contemporary scientific knowledge and Ayurvedic principles, the possible mechanisms of action of these medicines will be investigated. We'll talk about the difficulties and restrictions of combining AI diagnosis with customized Ayurvedic remedies.

This study used CNN to test the classification of skin diseases, specifically psoriasis and plaque. A total of 187 images—82 for plaque psoriasis and 105 for skin psoriasis—were used to assess the suggested approach. As shown in Table 1, the confusion matrix has been used to assess the outcomes of the psoriasis image categorization.

Table 1. The result of confusion matrix

Type of Psoriasis		Predicted Class	
		Plaque Psoriasis	Guttate Psoriasis
Actual Class	Plaque Psoriasis	68	14
	Guttate Psoriasis	29	76

The results of the Plaque and Skin Psoriasis classification confusion matrix are displayed in Table 1. In contrast to the 14 anticipated Plaque Psoriasis photos that are not categorized as actual Plaque Psoriasis images, Table 1 displays 68 predicted Plaque images that are classified as genuine Plaque images.

Therefore, TP has an accuracy rate of 82.9% and FN has an accuracy rate of 17.1% for Plaque Psoriasis skin illness. According to a tabulation, 76 out of 105 photographs are classed as true with the actual image for skin psoriasis, whereas 29 out of 105 images are not recognized as such. As a result, 72.4% of cases with skin psoriasis are classified as genuine (TP) and 27.6% as erroneous classification (FN). Consequently, this study found that CNN performed better in classifying skin diseases like as psoriasis and plaque, indicating a higher accuracy rate of TP for the problem at hand.

4. CONCLUSION

In this study, 187 photos—105 of which were of skin psoriasis and 82 of which were of plaque psoriasis—were subjected to a CNN-based non-invasive method for psoriasis skin disorders classification. It aims to enhance performance in recognizing the types of skin diseases such as plaque and psoriasis by using CNN. According to Table 1, the TP accuracy rate for Plaque Psoriasis skin illness is 82.9%, while 72.4% of TP are correctly classified for Skin Psoriasis skin disease.

With a correct classification rate of more than 80%, CNN is the best deep learning technique for psoriatic skin disorders. The findings of this study may potentially be used to other analyses of medical images. CNN's capacity to interpret data directly from raw pixels is the reason behind this. As a result, medical dermatology, especially in the area of psoriasis skin condition, benefits from this research as well.

By combining Ayurvedic principles with AI-powered diagnosis, this research aims to contribute to the development of a comprehensive approach to psoriasis management. The CNN-based psoriasis detection model's diagnostic accuracy and usability may be improved by GAN data augmentation. Researching herbal remedies and Ayurvedic concepts also offers an additional way to cure

psoriasis symptoms and improve patients' quality of life. Future research should concentrate on clinical studies to verify the effectiveness of integrating personalized Ayurvedic psoriasis therapies with AI-based diagnoses.

To get more precise and trustworthy results, additional research will be done in the future on modifying the CNN's pooling and fully connected layers' characteristics. As a medical tool to assist dermatologists in classifying psoriasis, it is believed that this research will soon be helpful and advantageous to the medical business.

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