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"Gabor Filter Based Skin Disease Detection Using Deep Learning"

Prof. Manjushree N S[1], Sathish M G [2], Shabaz khan [3], Sumanth K M [4], Swanson Shadrack [5]

Dept. of CS&E, Asst. Professor Bangalore Institute of Technology, Bengaluru, India[1]

Dept. of CS&E, Bangalore Institute of Technology, Bengaluru, India[2-5]

Abstract: Dermatological diseases rate has been increasing for past few decades. Most of these diseases tend to pass on from one person to another and are also based on visual perspectives, the dermatological diseases of one kind found on one part of the body might look different on another part of the body and diseases of different kinds on one part might look similar on other body parts. Skin diseases pose significant challenges in early detection and diagnosis, requiring accurate and efficient methods to improve patient outcomes. This report presents a novel Skin Disease Detection System that integrates Gabor filters and the deep learning models. The system leverages Gabor filters to extract texture features from skin lesion images, capturing unique patterns associated with various skin diseases. These features are concatenated and fed into a fine-tuned VGG16 model, which extracts high-level features and used CNN for predicting the type of skin disease. The system's workflow encompasses image preprocessing using Gabor filter, feature extraction using VGG16 model and disease classification using the CNN model, we predict four type of disease (Acne, Benign, Dermatitis, Eczema). By combining texture analysis and deep learning techniques, the system aims to enhance accuracy and assist dermatologists in efficiently screening and skin diseases. The proposed system has the potential to revolutionize skin disease, facilitating early intervention and improved patient care.

Keywords: Gabor filter, Deep learning algorithm – Convolutional neural network (CNN) and Visual geometry group 16(VGG16).

I. INTRODUCTION

Dermatology is a branch of medicine that deals with the study, diagnosis, and treatment of diseases and disorders related to the skin, hair, nails, and mucous membranes. It encompasses a wide range of conditions, including but not limited to skin infections, allergies, autoimmune disorders, skin cancer, dermatitis, psoriasis, acne, and eczema.

Skin diseases refer to any abnormal conditions affecting the skin, which may manifest as rashes, discoloration, itching, inflammation, or other visible symptoms. These diseases can have various causes, including genetic factors, environmental triggers, infections, immune system dysfunction, or underlying medical conditions. Proper diagnosis and treatment of skin diseases are crucial for managing symptoms, preventing complications, and improving patients' quality of life.

Dermatology and the understanding of skin diseases play a significant role in healthcare, as the skin serves as a protective barrier and reflects both internal and external health. The available diagnosis procedure consists of long laboratory procedures but this paper proposes a system which will enable users to predict the skin disease using computer vision.

1. Proposed System

The proposed solution in this system is a prototype with a dataset of four common skin diseases, using which a patient can self-diagnose and get some prior knowledge of their skin disease before consulting a dermatologist. This prototype can be used in mobile hospitals in rural areas. These days everybody is connected through mobile phones. Thus, this system can be accessed even in the most remote locations in the country.

The proposed system provides a non-invasive method of skin disease detection where the patient provides a picture of the infected area as an input to the prototype and any further analysis is done on this input image.
No pricking or prodding of the skin is required. The proposed system we are going to make use of Deep Learning algorithm of CNN to detect the skin disease.

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Propose a skin disease detection method based on Gabor Filter image processing technique. An image of the infected area of the skin is provided as an input to the prototype.
To make computer to interpret a lot of images and provide result with accuracy using technologies like: Gabor filter, CNN - Deep learning algorithm efficiently and effortlessly.
The Gabor filter is a linear filter used for texture analysis, which essentially means that it analyses whether there is any specific frequency content in the image in specific directions in a localized region around the point or region of analysis.

Figure 2.5.2 Image of Acne

The above Figure 2.5.2 is the image of Acne accepted as user input, the image is in the form of raw data where we apply Gabor filter for further analysis.

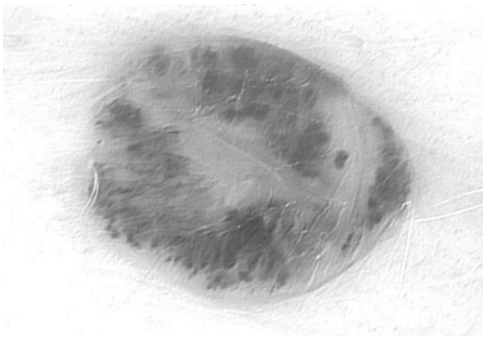

Figure 2.5.3 Gabor Filter applied Image of Acne

The image of Acne after Gabor filter is applied for texture analysis and they are used to detect small cloud stretches, blobs on the image and detects the edges on the image. The Gabor filter converts the skin disease image to grayscale if it is in color and normalizes the grayscale image to the range [0,1] and save the processed image in the ".npz" format in the directory.

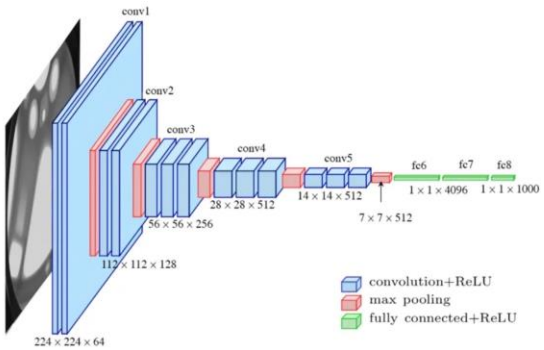

Figure 2.5.4 VGG16 Architecture

VGG16 a convolutional neural network. It is a pretrained version of the network trained on more than a million images from the ImageNet database. In this proposed model all the pretrained layers of VGG16 is freezed as we require only the

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Basic Model of VGG16 for Feature extraction. It Loads the train and testing dataset. Dataset are stored in .npz format, which contain images and corresponding labels.

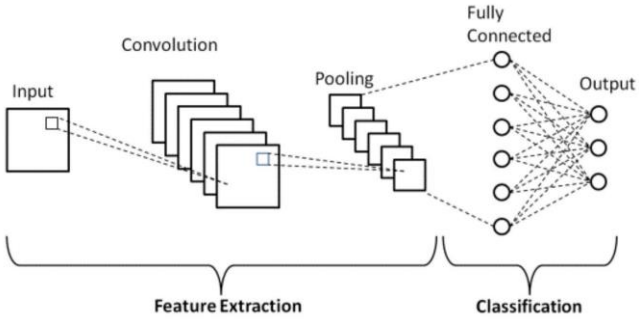

Figure 2.5.5 Structure of CNN

It has three layers namely, convolutional, pooling, and a fully connected layer. It is a class of neural networks and processes data having a grid-like topology. The convolution layer is the building block of CNN carrying the main responsibility for computation. First layer feature map will get generated by using relevant feature extracted from VGG16. Second layer will reduce the spatial dimension of feature map. Final layer will classify the image and predicts the type of skin disease.

II. PARAMETERS, RESULTS AND ANALYSIS

In this section, we have reported the results of our model and shown the analysis based on parameters such as model accuracy, precision, recall confusion matrix.

Classification Report

Classification Report

```
print(classification_report(y_true=y_true,y_pred=y_predict))
```

	precision	recall	f1-score	support
0	0.52	0.88	0.66	26
1	0.80	0.92	0.85	61
2	1.00	0.25	0.40	32
3	0.98	0.92	0.95	48
accuracy			0.78	167
macro avg	0.83	0.74	0.71	167
weighted avg	0.85	0.78	0.76	167

Figure 8.6 : Classification Report

The Figure 8.6 shows the classification report, which includes metrics such as precision, recall, and F1-score, comparing the true labels (y_true) and the predicted labels (y_predict).
It provides a comprehensive evaluation of the model's performance in terms of various metrics.

Confusion Matrix

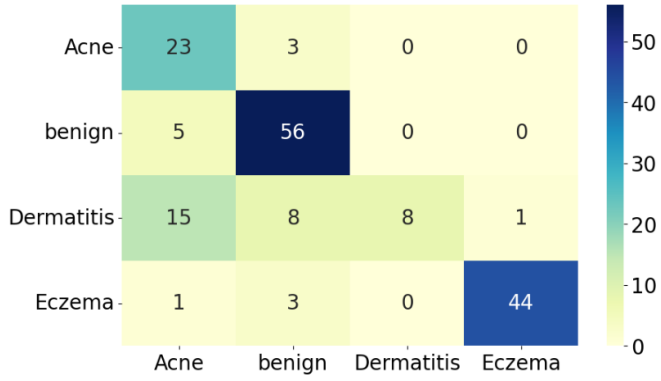

Figure 8.7 : Confusion Matrix

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It creates a heatmap using the confusion matrix, representing the classification results. The heatmap includes annotations, displays class labels on both axes, and uses a color map ("YlGnBu") to visualize the values. The resulting heatmap is displayed using a figure size of 10x6 inches.

Final Result

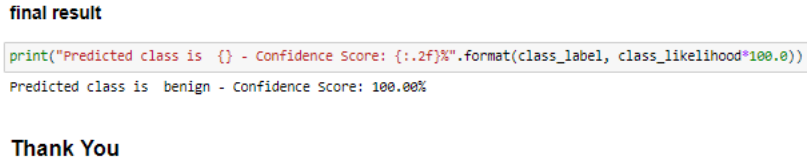

Figure 8.8: Final Result

The code prints the predicted class label and its corresponding confidence score in a formatted string, where the class label is represented by the variable "class_label" and the confidence score is represented by the variable "class_likelihood". The confidence score is displayed as a percentage with two decimal places.

III. CONCLUSION

The detection of skin diseases is crucial and early detection plays a vital role in effective treatment. In this project, a proposed system utilizing Gabor filters, Convolutional Neural Network (CNN), and VGG16 architecture has been developed for skin disease detection. The system showcases promising results, achieving an efficiency of over 80% in CNN based classification. Furthermore, the Gabor filter-based skin disease detection system, integrated with CNN and VGG16, presents a reliable and efficient approach for early diagnosis of skin diseases. The combination of these techniques holds great potential for improving healthcare practices and facilitating faster and more accurate detection of skin conditions.

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