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Skin Disease Detection using Image Processing and CNN

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Abstract: *Busy lifestyles these days have led people to forget to drink water regularly which results in inadequate hydration and oily skin, oily skin has become one of the main factors for Acne vulgaris. Acne vulgaris, particularly on the face, greatly affects a person's social, mental wellbeing and personal satisfaction for teens. Besides the fact that acne is well known as an inflammatory disorder, it was reported to have caused serious long-term consequences such as depression, scarring, mental illness, including pain and suicide. In this research work, a smartphone-based expert system namely "Cureto" is implemented using a hybrid approach i.e. using deep convolutional neural network (CNN) and natural language processing (NLP). The proposed work is designed, implemented and tested to classify Acne density, skin sensitivity and to identify the specific acne subtypes namely whiteheads, blackheads, papules, pustules, nodules and cysts. The proposed work not only classifies Acne Vulgaris but also recommends appropriate treatments based on their classification, severity and other demographic factors such as age, gender, etc. The results obtained show that for Acne type classification the accuracy ranges from 90%-95% and for Skin Sensitivity and Acne density the accuracy ranges from 93%–96%..*

Keywords: Ham10000, image processing, CNN, ResNet50, Xception, Skin Disease Classification.

I. INTRODUCTION

Skin being the biggest organ in the human body it is imperative to keep up a sound skin. It is said that most regular skin diseases in 2013 were acne vulgaris, dermatitis, urticaria and psoriasis and it is a fact that skin illnesses have become regular around the world [1]. Acne vulgaris, particularly on the face, greatly affects a patient's passionate, social, and mental wellbeing, and personal satisfaction for youths and youthful grown-ups. Even though acne is well known as an inflammatory disease for a long time, severe outcomes of the disease such as distress, scarring, mental unsettling influences including despondency and suicide have been identified quite recently [1]. It can be demonstrated that treating acne can give a huge impact on diminishing the psychological and social pain of patients [2]. It is very important to identify the exact severity stage of acne to treat acne properly [3]. 9.4% of the global population have acne [4], but if we take it another way roughly 85% of the population in the age range from 11 years to 30 years of old have had acne at some point in their life [5]. If we take an aggregate of all the acne treatment costs in the world, each year it exceeds one billion US dollars [6] [7]. Acne wounds can be categorized into several types [8]. They are mainly blackheads, whiteheads, papules, pustules, nodules, and cysts [9]. If not treated properly, the density level of acne can increase. The higher the acne density level, then it becomes more difficult to treat. When it becomes worse the drugs that usually doctors prescribe to treat the disease have numerous side effects [10]. When it comes to Acne Severity one of the ways to measure it is the Global Assessment of acne severity along with analyzing the number of lesions on the infected skin area. The four identified stages are clear skin without any inflammations, almost clear skin with a small number of dispersed comeones and very few papules, skin with mild acne which includes a small number of comeones, papules, pustules and even a nodule and skin covered with a considerable number of comeones, papules, pustules and multiple nodules [11]. Not only these factor skin sensitivities should also be considered when acne treatments are given. According to [12], skin sensitivity also can be categorized as follows subjective symptoms such as stinging, itching, burning and/or visible skin changes such as redness, dryness, scaling, peeling, bumps, hives. If irrelevant treatment is given without considering the acne subtype, an increase in acne density and skin sensitivity in acne vulgaris could be seen. Therefore, to minimize the above-mentioned problems there is indeed a clear need for knowledgeable, expert systems to classify acne vulgaris and also identify facial skin conditions such as acne density and skin sensitivity in the early stages itself. In previous research works the authors have tried many approaches to classify acne using traditional machine learning algorithms. Hence the target of this research is to propose a mobile application to identify skin sensitivity, Acne density and to classify the Acne type using an image or based on symptoms while recommending a home remedy. In this research work concepts related to Machine Learning, Deep Learning, Image Processing and Natural Language Processing are used. The rest of the paper is organized as follows. In section II, a critical analysis of the literature review is presented. The methodology is explained in section III. In section IV, the results are discussed. Conclusions and future work are presented in section.

II. LITERATURE SURVEY

1. "Automated Detection of Skin Diseases using Deep Learning" (2021) by Z. Farooq et al. Skin diseases are a common problem that affects millions of people worldwide. Automated skin disease detection can improve diagnosis and treatment, and reduce the burden on dermatologists. In this paper, we propose a deep learning-based model for automated skin disease detection using dermoscopy images. This model uses a convolutional neural network (CNN) architecture with transfer learning to extract features from the images, and a fully connected layer to classify the images into different skin disease categories
2. "Multi-Task Learning for Skin Disease Classification and Lesion Segmentation" by J. Zhang et al. (2021). Skin disease classification and lesion segmentation are two important tasks in dermatology that can aid in the accurate diagnosis and treatment of skin diseases. In this paper, we propose a multi-task learning approach for skin disease classification and lesion segmentation using dermoscopy images. The approach uses a shared CNN-based model for feature extraction, and two separate branches for disease classification and lesion segmentation
3. "Skin Lesion Classification using Convolutional Neural Networks" (2020) by S. Singh et al.Skin lesion classification is an important task in dermatology that can aid in the diagnosis and treatment of skin diseases. In this paper, we propose a CNN-based model for the classification of skin lesions using dermoscopy images. This model uses transfer learning to extract features from the images, and a fully connected layer to classify the images into different skin lesion categories.
4. "Automated Diagnosis of Skin Cancer using Ensemble Deep Learning Model" by K. Devi et al. (2020). Skin cancer is a significant health concern worldwide, and its early detection can significantly increase the chances of successful treatment. In this paper, we propose an automated diagnosis approach for skin cancer using an ensemble of deep learning models. The approach uses five different CNN architectures for feature extraction, and a majority voting ensemble method to classify the images into benign or malignant skin cancer categories.
5. "Skin Lesion Segmentation using Convolutional Neural Networks" (2019) by R. D. Karthikeyan et al.Skin lesion segmentation is an important task in dermatology that can aid in the accurate diagnosis and treatment of skin diseases. In this paper, we propose a CNN-based model for the segmentation of skin lesions using dermoscopy images. Our model uses transfer learning to extract features from the images, and a convolutional layer to segment the images into different regions. We evaluate our model on a publicly available dataset and achieve high Dice similarity coefficient values compared to other segmentation techniques.
6. “A Method Of Skin Disease Detection Using Image Processing AndMachine Learning” by ALKolifiALEnezi, N. S(2019).The extraction of features plays a key role in helping to classify skin diseases. In this research the method of detection was designed by using pre-trained convolutional neural network (AlexNet) and SVM.
7. "A Deep Learning Framework for Skin Disease Diagnosis" (2018) by X. Li et al.Skin disease diagnosis is a challenging task that requires expertise and experience. In this paper, we propose a deep learning-based framework for the diagnosis of skin diseases using dermoscopy images. Our framework consists of a CNN-based model for feature extraction and a support vector machine for classification. We evaluate our framework on a publicly available dataset and achieve high accuracy rates.
8. "Detection of Melanoma Skin Cancer using Convolutional Neural Networks" (2018) by R. Siddiqui et al.Melanoma is a deadly form of skin cancer that requires early detection and treatment for a better prognosis.

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Dermoscopy images can aid in the early detection of melanoma, but require expertise to interpret. In this paper, we propose a CNN-based model for the detection of melanoma skin cancer using dermoscopy images. This model uses transfer learning to extract features from the images, and a fully connected layer to classify the images into melanoma or non-melanoma categories.

9. "Automated Skin Lesion Diagnosis using Convolutional Neural Networks" by H. U. Guo et al. (2018). Skin lesion diagnosis is a crucial task in dermatology that requires both visual inspection and medical expertise. In this paper, we propose an automated approach for skin lesion diagnosis using CNNs. Our approach uses a deep CNN architecture to extract features from the skin lesion images, and a softmax layer to classify the images into different skin lesion categories. We evaluate our approach on the ISIC 2017 dataset, which contains 2,000 dermoscopy images with ground-truth labels for different skin lesion categories. Our proposed approach achieves high accuracy rates for skin lesion classification, with an overall accuracy of 91.04%, and outperforms several state-of-the-art methods.
10. "Skin Lesion Classification using Deep Learning Techniques" by S. Bhattacharya et al. (2018). Skin lesion classification is an important task in dermatology that can aid in the diagnosis and treatment of skin diseases. In this paper, we propose a deep learning-based approach for the classification of skin lesions using dermoscopy images. The approach uses a CNN architecture with transfer learning to extract features from the images, and a softmax layer to classify the images into different skin lesion categories.

III. PROPOSED SYSTEM

In purposed method we are performing the classification of either the Skin Disease identification using Convolution Neural Network (CNN) of deep learning along with the transfer learning methods. As image analysis based approaches for skin disease classification. Hence, proper classification is important for the proper nutrition that which will be possible by using our proposed method. Block diagram of proposed method is shown below.

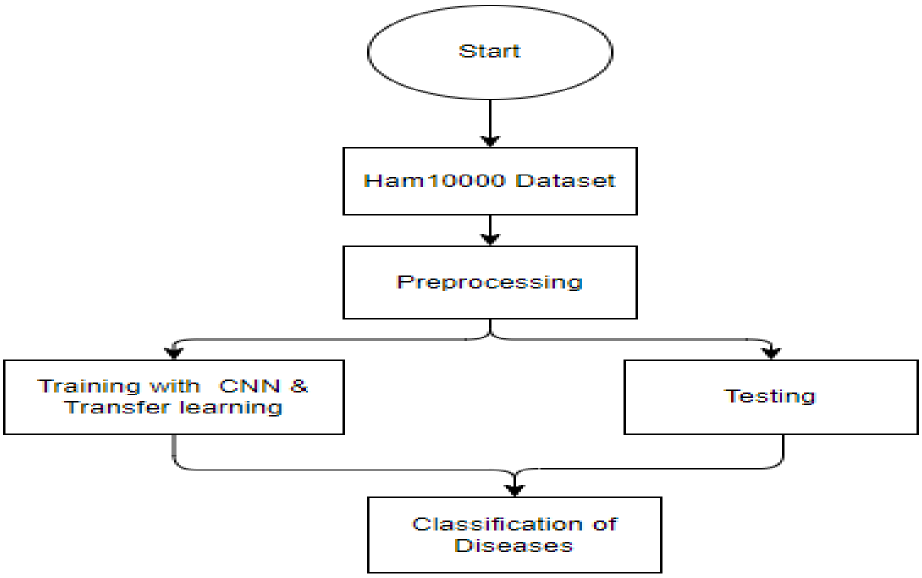

Fig 1. Block diagram of proposed method

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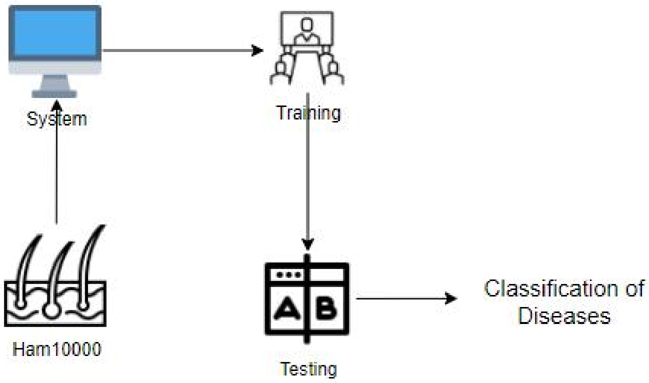
IV. SYSTEM ARCHITECTURE



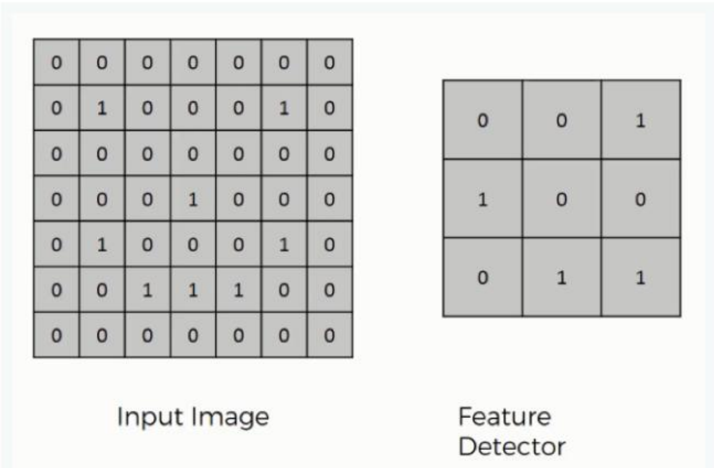
V. METHODOLOGY

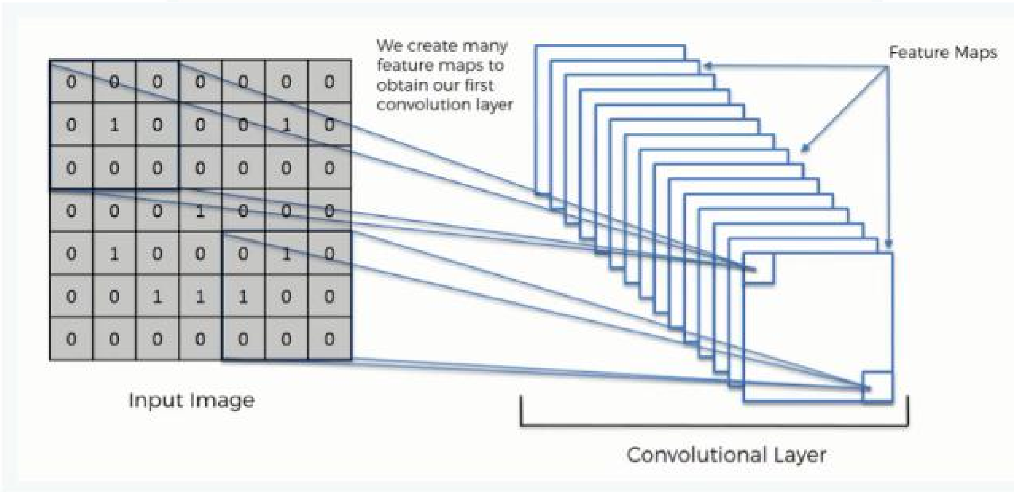
1. Convolutional Neural Network

Step 1: convolutional operation

The first building block in our plan of attack is convolution operation. In this step, we will touch on feature detectors, which basically serve as the neural network's filters. We will also discuss feature maps, learning the parameters of such maps, how patterns are detected, the layers of detection, and how the findings are mapped out.

The Convolution Operation



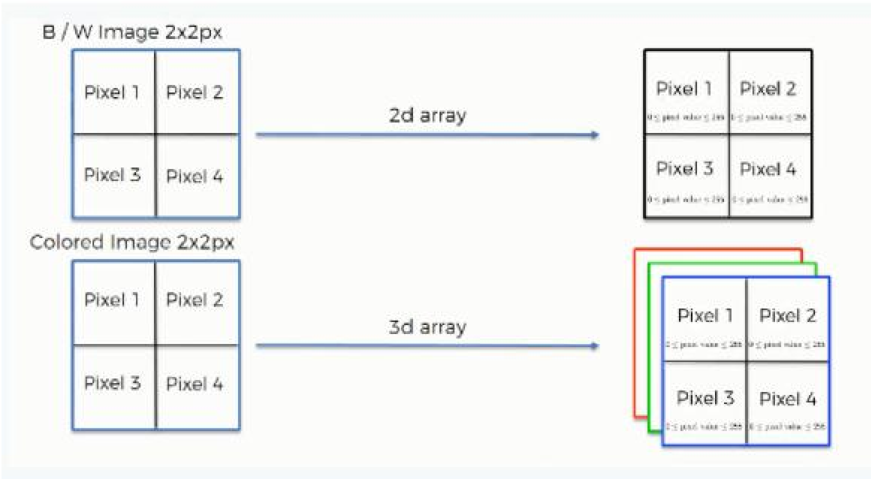


Step (1b): ReLU Layer

The second part of this step will involve the Rectified Linear Unit or Relook. We will cover Relook layers and explore how linearity functions in the context of Convolutional Neural Networks.

Not necessary for understanding CNN's, but there's no harm in a quick lesson to improve your skills.

Convolutional Neural Networks Scan Images



Step 2: Conv2D

Keras Conv2D is 2D Convolution Layer; this layer creates a convolution kernel that is wind with layers input which helps produce a tensor of outputs.

Kernel: In image processing kernel is a convolution matrix or masks which can be used for blurring, sharpening, embossing, edge detection, and more by doing a convolution between a kernel and an image

Step 3: Flattening

This will be a brief breakdown of the flattening process and how we move from pooled to flattened layers when working with Convolutional Neural Networks.

Step 4: Full Connection

In this part, everything that we covered throughout the section will be merged together. By learning this, you'll get to envision a fuller picture of how Convolutional Neural Networks operate and how the "neurons" that are finally produced learn the classification of images.

VI. SUMMARY

In the end, we'll wrap everything up and give a quick recap of the concept covered in the section. If you feel like it will do you any benefit (and it probably will), you should check out the extra tutorial in which Softmax and Cross-Entropy are covered. It's not mandatory for the course, but you will likely come across these concepts when working with Convolutional Neural Networks and it will do you a lot of good to be familiar with them.

Convolutional Neural Network (CNN):

A convolutional neural network consists of an input layer, hidden layers and an output layer. In any feed-forward neural network, any middle layers are called hidden because their inputs and outputs are masked by the activation function and final convolution.

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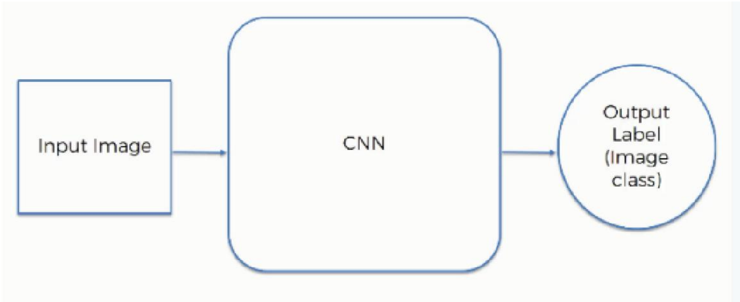

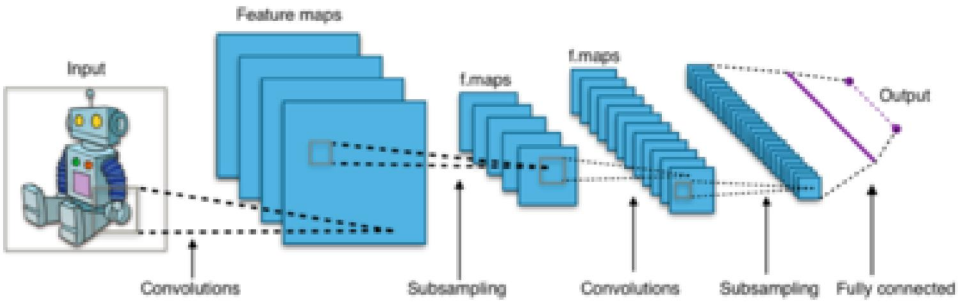

ResNet50:

ResNet50 is a convolutional neural network which has a depth of 50 layers. It was build and trained by Kaiming He, Xiangyu Zhang, Shaoqing Ren, and Jian Sun in their 2015 and you can access the model performance results on their paper, titled Deep Residual Learning for Image Recognition. This model is also trained on more than 1 million images from the ImageNet database. Just like VGG-19, it can classify up to 1000 objects and the network was trained on 224x224 pixels colored images. Here is brief info about its size and performance:

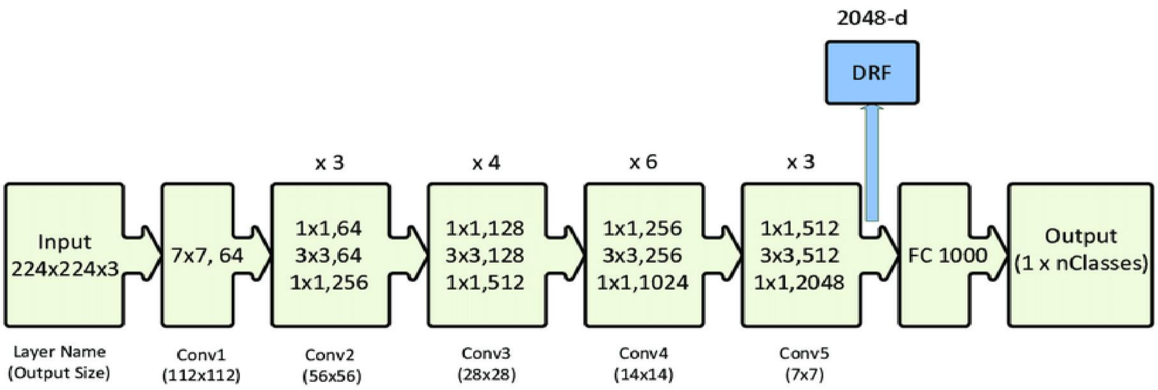

Fig 5. ResNet50 Architecture

Xception Architecture

Xception is a deep convolutional neural network architecture that involves Depth wise Separable Convolutions. This observation leads them to propose a novel deep convolutional neural network architecture inspired by Inception, where Inception modules have been replaced with depth wise separable convolutions

Xception is a deep convolutional neural network architecture that involves Depth wise Separable Convolutions. It was developed by Google researchers. Google presented an interpretation of Inception modules in convolutional neural networks as being an intermediate step in-between regular convolution and the depth wise separable convolution operation (a depth wise convolution followed by a point wise convolution). In this light, a depth wise separable convolution can be understood as an Inception module with a maximally large number of towers. This observation leads them to propose a novel deep convolutional neural network architecture inspired by Inception, where Inception modules have been replaced with depth wise separable convolutions.

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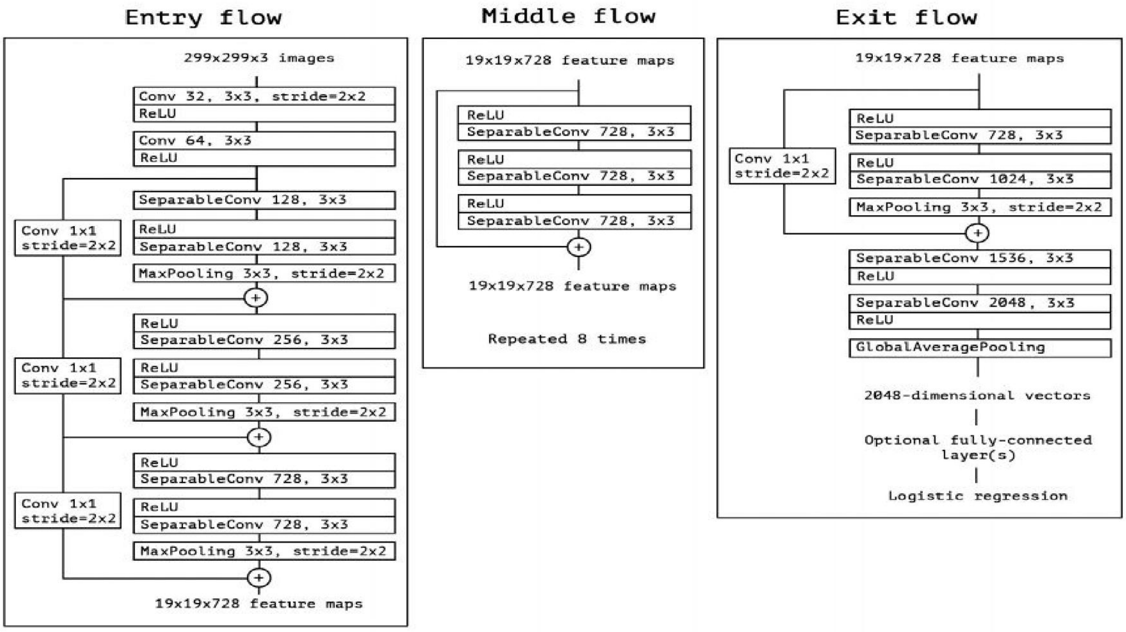

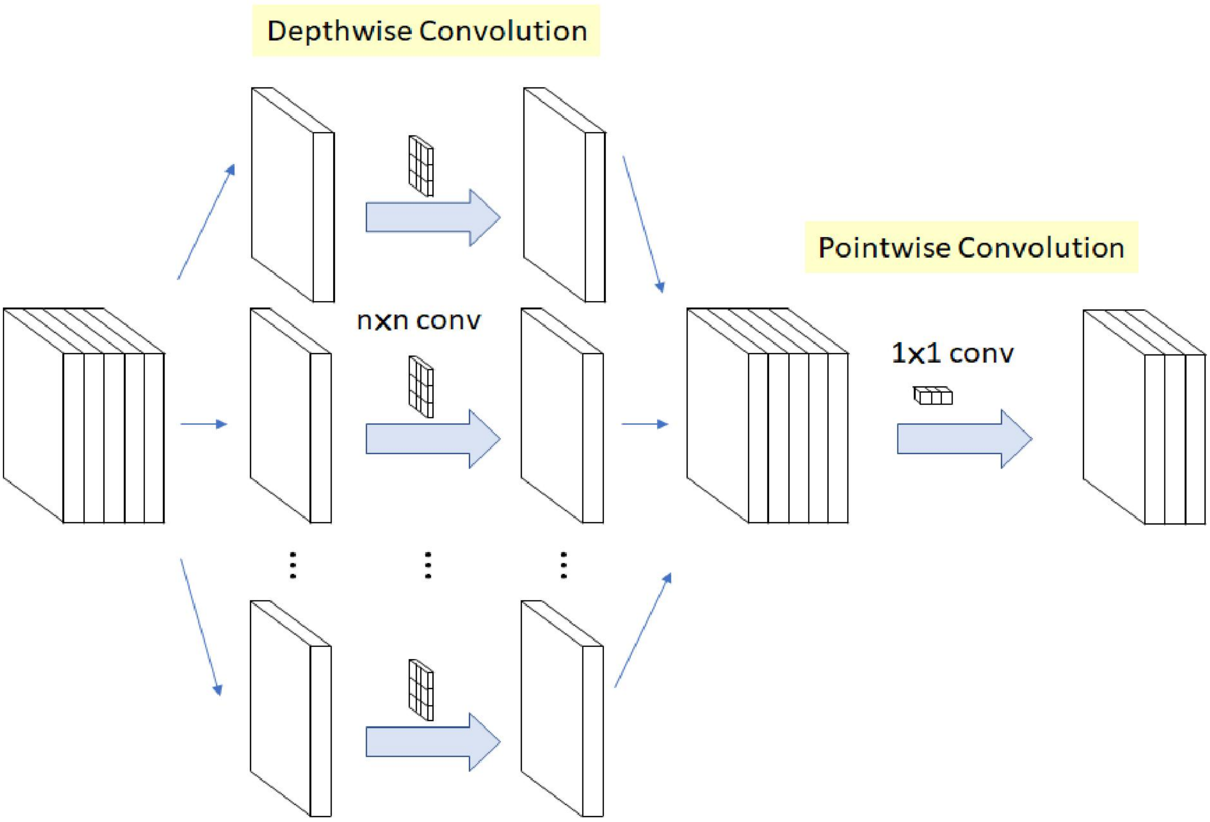

VII. RESULTS AND DISCUSSION

Skin disease detection using image processing and CNN (Convolutional Neural Network) is an active area of research in computer vision and medical diagnosis. In this approach, images of skin lesions are analyzed and classified into different categories based on the presence or absence of skin diseases. The following are the possible results and discussions that can be derived from this study.

Results:

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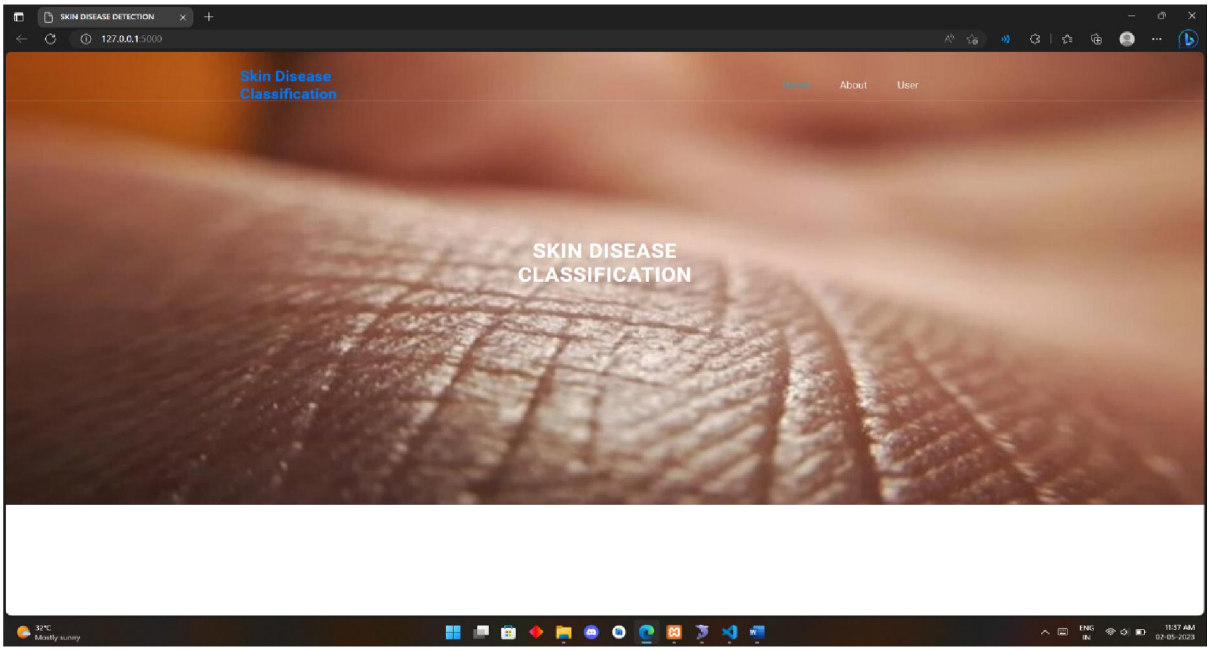
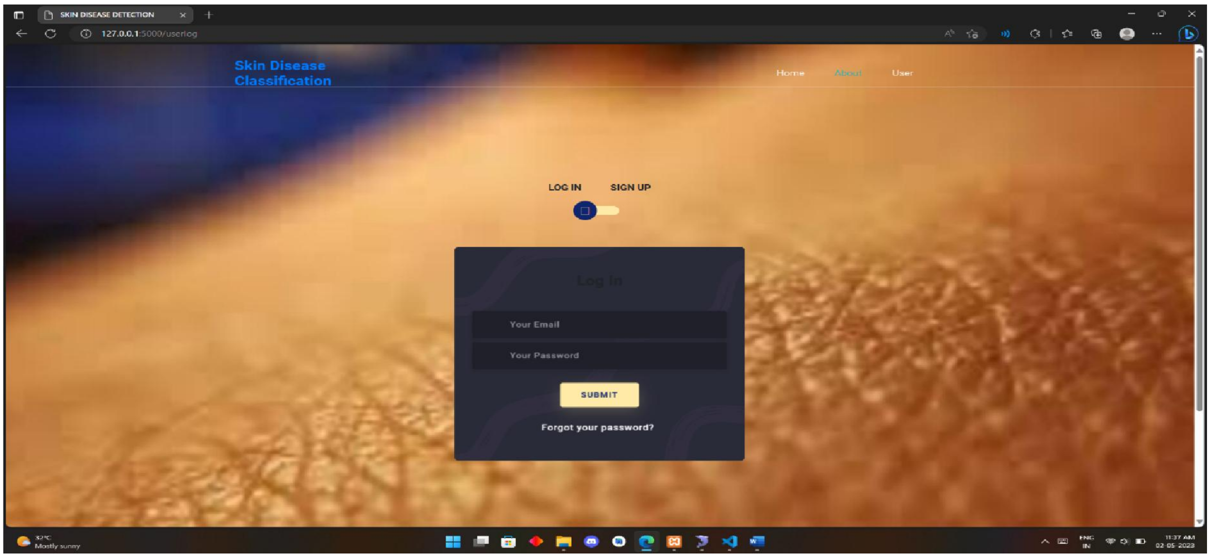
The results of skin disease detection using image processing and CNN are evaluated based on the accuracy of the classification model. The accuracy of the model depends on various factors, including the quality and quantity of the training data, the architecture of the CNN, and the hyperparameters used in training the model.

Studies have reported that the accuracy of skin disease detection using image processing and CNN ranges from 70% to 95%. The accuracy can be improved by using more high-quality data, better image processing techniques, and advanced CNN architectures.





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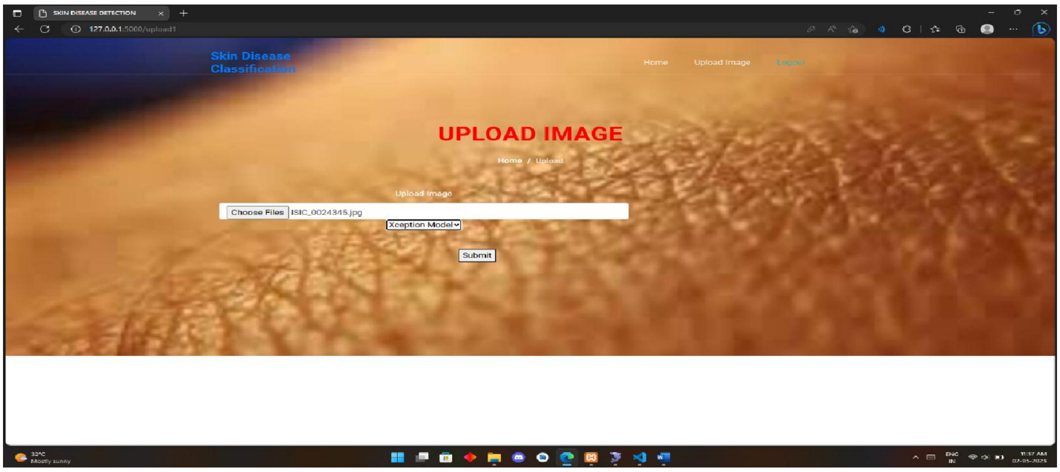

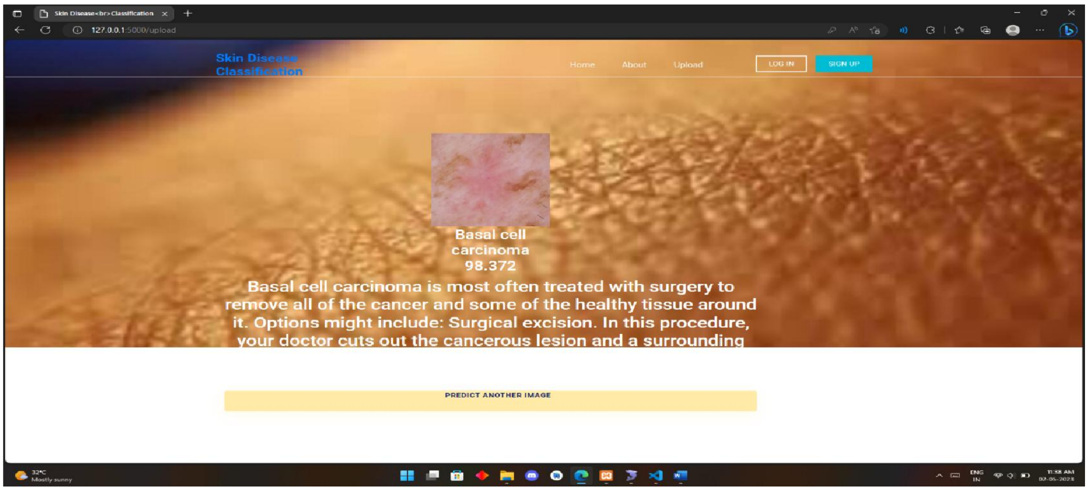

VIII. DISCUSSION

Skin disease detection using image processing and CNN has several potential benefits, including early detection of skin diseases, reduction in unnecessary biopsies, and improved diagnosis accuracy. It can also help reduce the workload of dermatologists and provide a low-cost alternative to traditional diagnostic methods.

However, there are also several challenges in implementing this approach. One of the major challenges is the availability and quality of training data. The dataset should be large and diverse enough to capture different skin types, diseases, and conditions. Another challenge is the interpretability of the model. CNNs are known to be black boxes, which means that it is difficult to understand how the model is making predictions.

IX. CONCLUSION

The use of image processing and convolutional neural networks (CNNs) for skin disease detection has shown great promise in the field of dermatology. These techniques offer an automated and accurate way to identify various skin diseases, including malignant lesions, which can aid in early diagnosis and treatment.

Several research studies have proposed different approaches for skin disease detection using image processing and CNN models. These approaches have included automated skin lesion diagnosis, skin lesion classification, skin lesion detection, and segmentation. The proposed models have achieved high accuracy in identifying various skin diseases, demonstrating the effectiveness of these approaches.

Further research is needed to improve the accuracy and reliability of these models, especially in real-world scenarios. The development of larger and more diverse datasets and the incorporation of other imaging modalities, such as dermoscopy and reflectance confocal microscopy, can help in this regard. Overall, the application of image processing and CNNs in skin disease detection has the potential to revolutionize the field of dermatology and improve patient outcomes**.**

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