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A Comparative Study on Skin Cancer Detection Using Transfer Learning Models and CNN

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ABSTRACT

Dermatological diseases are the most common diseases in the world. Despite its prevalence, diagnosis is extremely difficult and necessitates extensive experience in the field. In this project, we present a method for detecting various types of these diseases. Computer vision and machine learning are two stages that we used to accurately identify diseases. The project's goal is to easily and accurately detect the type of skin disease and recommend the best treatment. The skin disease is subjected to various types of pre-processing techniques in the first stage of the image, followed by feature extraction. The second stage involves using machine learning algorithms to identify diseases based on skin analysis and observation. The proposed system is especially useful in rural areas where dermatologists are scarce. For the experimental results of this proposed system, we use a Pycharm-based Python script. Skin diseases are the most common around the world, as people get skin diseases due to genetics and environmental factors. In many cases, people ignore the early signs of skin disease. In the current system, skin diseases are identified through a biopsy process, which is then analyzed and medications are prescribed manually by physicians. We propose a hybrid approach combining computer vision and machine learning techniques to overcome this manual inspection and provide promising results in a short period of time. The input images for this would be microscopic images, such as histopathological images, from which features such as colour, shape, and texture would be extracted and fed into a convolutional neural network (CNN) for classification and disease identification. The project's goal is to easily detect the type of skin disease and recommend the best and most comprehensive medical recommendations. Skin disease much more rapidly and precisely. However, the cost of such a diagnosis is still limited and prohibitively expensive. Thus, image processing techniques aid in the development of an automated screening system for dermatology at an early stage. The extraction of features is critical in the classification of skin diseases. In a variety of techniques, computer vision plays a role in the detection of skin diseases. Skin diseases are common in Saudi Arabia due to the deserts and hot weather. This work advances the study of skin disease detection. We proposed a method for detecting skin diseases based on image processing.

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

I. INTRODUCTION

Skin diseases are more common than other types of illnesses. Skin diseases can be caused by a fungal infection, bacteria, allergies, or viruses, among other things. A skin disease can cause changes in the texture or colour of the skin. Skin diseases are generally chronic, infectious, and can sometimes progress to skin cancer. As a result, skin diseases must be detected early in order to limit their progression and spread. Skin disease diagnosis and treatment take longer and incur financial and physical costs for the patient. In general, most people are unaware of the type and stage of a skin disease. Some skin diseases manifest symptoms months later, causing the disease to develop and spread. This is because of a lack of medical knowledge in the public. A dermatologist (skin specialist doctor) may also struggle to diagnose the skin disease and may require costly laboratory tests to correctly identify the type and stage of the skin disease. The advancement of laser and photonics-based medical technology has allowed for much faster and more accurate diagnosis of skin diseases. However, the cost of such a diagnosis is still limited and prohibitively expensive. As a result, we propose an image processing-based approach to skin disease diagnosis. This method uses image analysis to identify the type of disease by taking a digital image of the diseased skin area. Our proposed method is simple, quick, and requires no expensive equipment other than a camera and a computer.

Skin is the largest organ of the human body, composed of epidermis, dermis, and subcutaneous tissues, and contains blood vessels, lymphatic vessels, nerves, and muscles that can perspire, sense external temperature, and protect the body. The skin, which covers the entire body, can protect multiple tissues and organs from external invasions such as artificial skin damage, chemical damage, adventitious viruses, and individuals' immune systems. Furthermore, skin can avoid the loss of lipids and water within the epidermis and dermis, allowing the skin barrier function to be stabilized. Skin is not indestructible, despite its defence and barrier function, because it is constantly influenced by a variety of external and genetic factors. There are currently three types of skin diseases that appear in the human body: viral skin diseases, fungal skin diseases, and allergic skin diseases. Despite the fact that these types of skin diseases are currently curable, they have caused patients' lives to be disrupted. Nowadays, the majority of conclusions on patients' existing symptoms are based primarily on doctors' years of experience or their own subjective judgments, which can lead to errors and, as a result, delay treatment of these patients. As a result, it is both theoretically and practically significant to investigate how to extract symptoms of various skin diseases using modern science and technology. Under these conditions, it is possible to identify the types of skin diseases and prescribe treatment based on the symptoms of the patients. The image processing technique has advanced rapidly in medicine over the last few years. Some digital image technology-based equipment, such as computed tomography (CT), digital subtraction angiography (DSA), and magnetic resonance imaging (MRI), has also been widely used in people's daily lives (MRI). Scholars from all over the world have conducted additional research in this area. Oyola and Arroyo, for example, detected the skin disease varicella using image processing techniques such as colour transformation, equalisation, and edge detection, and the image of varicella was eventually collected and classified using the Hough transform. +e final empirical results showed that a better diagnosis was received in terms of varicella detection, and preliminary tests on varicella and

herpes zoster were also conducted on that basis. Chung and Sapiro proposed a method for detecting the image of skin lesions using a partial differential equation (PDE), with which a contour model of skin lesions was extracted based on its morphological filtering via PDE.

Humans are prone to skin diseases. They are usually caused by factors such as different cells in the organism, a different diet, and internal and external factors such as the hierarchical genetic group of cells, hormones, and immune system of conditions. These factors may act together or sequentially to cause skin disease. Chronic and incurable diseases such as eczema and psoriasis exist alongside malignant diseases such as malignant melanoma. Recent research has discovered that if these diseases are detected in their early stages, cures are available. Atopic dermatitis, also known as eczema, is a chronic skin disease characterized by dry and itchy skin, rashes on the face, inside the elbows, behind the knees, and on the hands and feet. Melanoma is a severe and potentially fatal form of skin cancer. Asymmetry, Border, Color, and Diameter are the "ABCD's" of skin moles. Asymmetry means that the shape of one half does not match the shape of the other half. Border indicates that the mole's edges are ragged, blurred, or irregular. The colour is uneven and may include black, brown, and tan shades. The diameter of a mole indicates a size change.

II. RELATED WORKS

Yasir, R., Rahman, M. A., & Ahmed, N. Skin diseases are among the most common health issues in the world. In this article, we proposed a method for detecting dermatological skin diseases using computer vision techniques. For feature extraction, we used a variety of image processing algorithms, as well as a feed forward artificial neural network for training and testing. The system operates in two stages: first, it pre-processes colour skin images to extract significant features, and then it identifies diseases. With a 90% accuracy rate, the system detects 9 different types of dermatological skin diseases. Dermatology is the branch of medicine that deals with hair, nails, and skin diseases. It is a specialty that encompasses both medical and surgical aspects. A dermatologist treats diseases in their broadest sense, as well as some cosmetic issues with the skin, scalp, hair, and nails. Due to the complexity of jaggedness, tone, hair presence, and other mitigating features, human skin is one of the most unpredictable and difficult terrains to automatically synthesise and analyse. Going to a dermatologist for skin disease treatment is prohibitively expensive in a developing country like Bangladesh. Every year, a large number of people in developing countries such as Bangladesh suffer from various types of skin diseases. As a result, having an automated skin disease detection system is critical for both patients and dermatologists, especially in developing countries. Several studies have been conducted to detect dermatological skin diseases using computer vision-based techniques, but almost all of them only worked for 2-3 diseases. We have worked to detect 9 different types of skin diseases in our work. Eczema, Acne, Leprosy, Psoriasis, Scabies, Foot Ulcer, Vitiligo, Tinea Corporis, and Pityriasis Rosea are among them. For image preprocessing, we used eight different types of algorithms (YCbCr, grey image, sharpening filter, median filter, smooth filter, binary mask, and histogram and sobel operator).

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Wu, H., Yin, H., Chen, H., Sun, M., Liu, X., Yu, Y. Lu, Q.: Inflammatory skin diseases are skin disorders characterised by inflammatory cell infiltration and significantly elevated inflammatory cytokines. Inflammatory skin diseases affect more than one-fifth of the global population. Psoriasis (Pso), eczema (Ecz), and atopic dermatitis (AD) are examples of inflammatory skin diseases. Dermatologists typically diagnose these diseases based on a "first impression," which is then confirmed by pathological analysis and laboratory tests. However, less experienced dermatologists and young dermatologists are especially prone to errors because Pso, Ecz, and AD are easily misdiagnosed. To address this issue and assist dermatologists, we created an end-to-end deep learning model based on clinical skin images for automated diagnosis of Pso, Ecz, and AD in this study. Convolutional neural networks (CNNs) have demonstrated great power for clinical image analysis, and a growing number of studies have reported promising results for CNNs in a variety of diseases. CNNs, for example, have been used to aid in the early diagnosis and detection of Alzheimer disease using brain electroencephalogram (EGG) spectral images and MRIs, to predict the risk of osteoarthritis using knee cartilage MRIs, to segment multiple sclerosis lesions using multichannel 3D MRIs, to diagnose breast nodules and lesions using ultrasound images, and to detect diabetic retinopathy using retinal fundus photographs. CNNs in dermatology arose from the development of pioneering technologies to aid in melanoma diagnosis. There are now numerous examples of AI tools that aid in cancer diagnosis using data from dermoscopes and histological images of skin biopsy tissues. However, to the best of our knowledge, no AI tools have been used to assist in the diagnosis of skin diseases other than cancer.

T. Swapna1, D.A. Vineela, M. Navyasree, N. Sushmtha, P. Bhavana: Skin disease among humans has been a common disease, millions of people are suffering from various kinds of skin diseases. Usually, these diseases have hidden dangers which lead to not only lack of self-confidence and psychological depression but also lead to a risk of skin cancer. Medical experts and high-level instruments are needed to diagnosis these skin diseases due to non-availability of visual resolution in skin disease images.

The proposed framework includes deep learning techniques such as CNN architecture and three predefined models called Alex Net, ResNet, InceptionV3. A Dataset of images with seven diseases has been taken for the Classification of Skin diseases. They include diseases like Melanoma, Nevus, Seborrheic Keratosis etc. The dataset was extended by adding images having cuts and burns, which were classified as skin disease by most of the existing systems. The usage of Deep Learning algorithms has reduced the need for human labor, such as manual feature extraction and data reconstruction for classification purposes. Skin is one in every of the most important and quickest developing tissues of the human body. The burden of skin disease is regarded as a multidimensional concept that comprehends psychological, social and economic significance of the skin disease at the sufferers and their households and on society. It is a contamination that takes place in humans of all ages. Skin is regularly broken due to the fact it's far a touchy a part of the body. There are more than 3000 skin diseases. A cosmetically look spoiler disease will have a big effect and might reason extensive ache and everlasting injury. Most of the chronic skin conditions, along with atopic eczema, psoriasis, vitiligo and leg ulcers, aren't right now deadly, they may be diagnosed as an extensive problem on fitness popularity which include physical, emotional and economic outcome. On the other hand, skin cancers are potentially lethal and their trouble is associated with the temporality that they carry.

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III. Methodology

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.

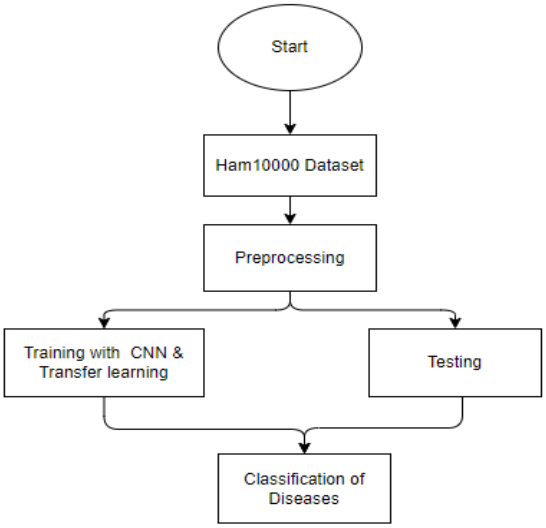


Figure 1: Block diagram

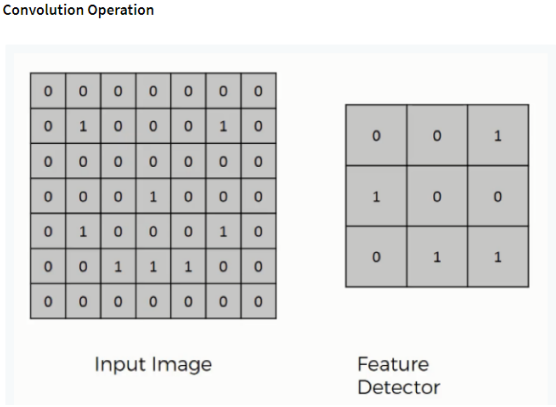
3. Implementation:

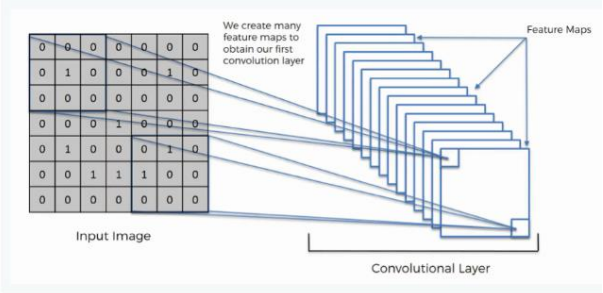
The algorithms listed below were used to complete the project.

1. Convolutional Neural Network

Step1: 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.



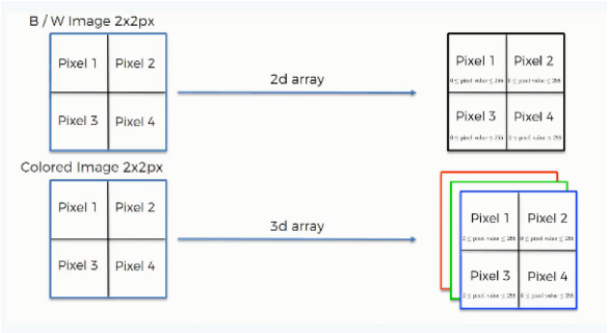


Step (1b): ReLU Layer

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

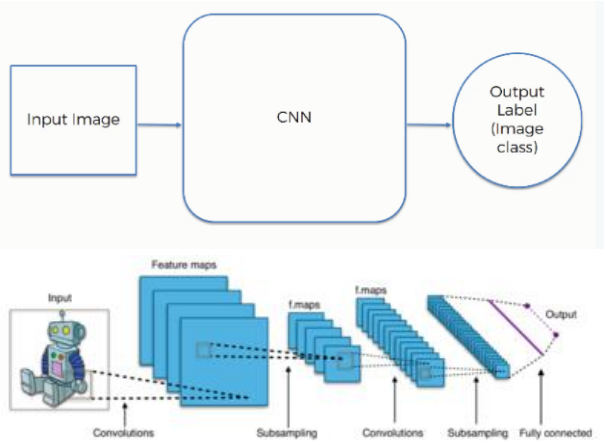
In this part, everything that we covered throughout the section will be merged together. By learning this, you'll get to envision a fuller picture of how Convolutional Neural Networks operate and how the "neurons" that are finally produced learn the classification of images.

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):

An input layer, hidden layers, and an output layer comprise a convolutional neural network. Any middle layers in a feed-forward neural network are referred to as hidden because their inputs and outputs are masked by the activation function and final convolution.



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.

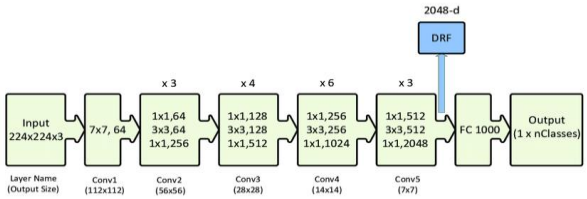


Fig. ResNet50 Architecture

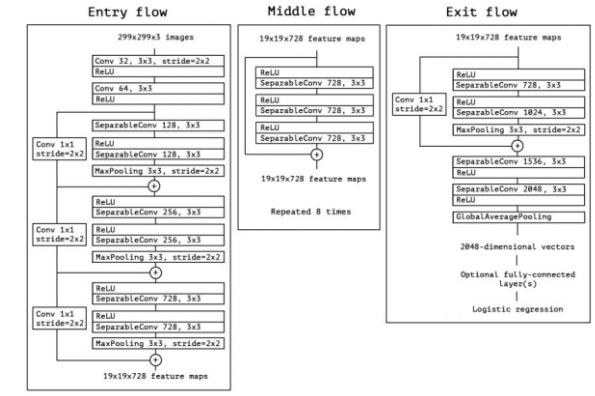
To sum up, residual network or ResNet was a major innovation that has changed the training of deep convolutional neural networks for tasks related to computer vision. While the original ResNet had 34 layers and used 2-layer blocks, other advanced variants such as the Resnet50 made the use of 3-layer bottleneck blocks to ensure improved accuracy and lesser training time. Keras is a deep learning API that is popular due to the simplicity of building models using it. Keras comes with several pre-trained models, including Resnet50 that anyone can use for their experiments. Therefore, building a residual network in Keras for computer vision tasks like image classification is relatively simple. You only need to follow a few simple steps.

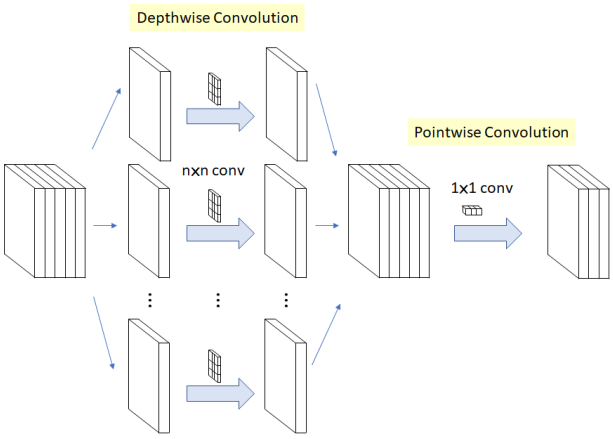
Xception Architecture

Xception is a deep convolutional neural network architecture with Depth wise Separable Convolutions. This observation inspires them to propose a new deep convolutional neural network architecture inspired by Inception, in which Inception modules are replaced with depth wise separable convolutions.

Xception is a deep convolutional neural network architecture with Depth wise Separable Convolutions. It was created by Google scientists. Inception modules in convolutional neural networks were interpreted by Google as an intermediate step between regular convolution and the depth wise separable convolution operation (a depth wise convolution followed by a point wise convolution). In this context, a depth wise separable convolution can be thought of as an Inception module with an infinite number of towers.

This observation inspires them to propose a new deep convolutional neural network architecture inspired by Inception, in which Inception modules are replaced with depth wise separable convolutions.

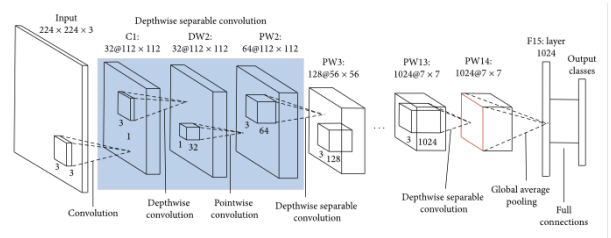




3. MobileNet:

As the name applied, the MobileNet model is designed to be used in mobile applications, and it is TensorFlow's first mobile computer vision model.

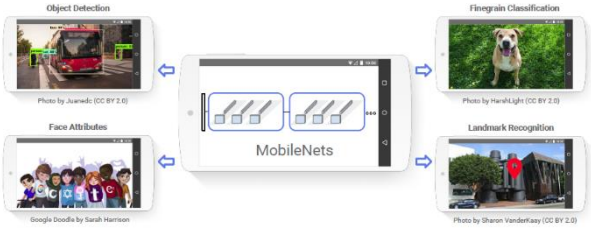
MobileNet uses **depthwise separable convolutions.** It significantly **reduces the number of parameters** when compared to the network with regular convolutions with the same depth in the nets. This results in lightweight deep neural networks.



A depthwise separable convolution is made from two operations.

1. **Depthwise convolution.**
2. **Pointwise convolution**.

MobileNet is a class of CNN that was open-sourced by Google, and therefore, this gives us an excellent starting point for training our classifiers that are insanely small and insanely fast.



Depthwise Separable Convolution

This convolution originated from the idea that a filter's depth and spatial dimension can be separated- thus, the name separable. Let us take the example of Sobel filter, used in image processing to detect edges.

-1	0	+1
-2	0	+2
-1	0	+1

Gx

+1	+2	+1
0	0	0
-1	-2	-1

Gy

Sobel Filter. Gx for the vertical edge, Gy for horizontal edge detection

You can separate the height and width dimensions of these filters. Gx filter can be viewed as a matrix product of [1 2 1] transpose with [-1 0 1].

We notice that the filter had disguised itself. It shows it had nine parameters, but it has 6. This has been possible because of the separation of its height and width dimensions.

The same idea applied to separate depth dimension from horizontal (width*height) gives us depth-wise separable convolution whare we perform depth-wise convolution. After that, we use a 1*1 filter to cover the depth dimension.

One thing to notice is how much parameters are reduced by this convolution to output the same no. of channels. To produce one channel, we need 3*3*3 parameters to perform depth-wise convolution and 1*3 parameters to perform further convolution in-depth dimension.

But If we need three output channels, we only need 31*3 depth filter, giving us a total of 36 (= 27 +9) parameters while for the same no. of output channels in regular convolution, we need 33*3*3 filters giving us a total of 81 parameters.

Depthwise separable convolution is **a depthwise convolution followed by a pointwise convolution** as follows:

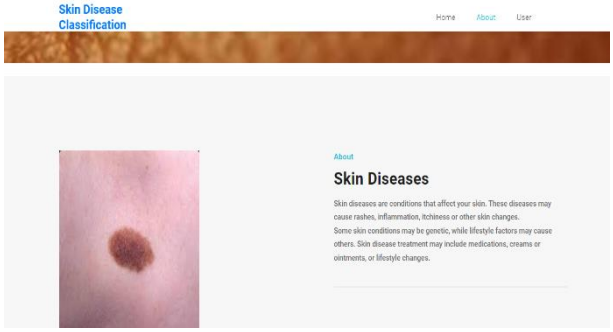
1. **Depthwise convolution** is the **channel-wise DK×DK spatial convolution**. Suppose in the figure above, and we have five channels; then, we will have 5 DK×DK spatial convolutions.
2. **Pointwise convolution** is the **1×1 convolution** to change the dimension.
3. **Depthwise convolution.**

4. Results and Discussion:

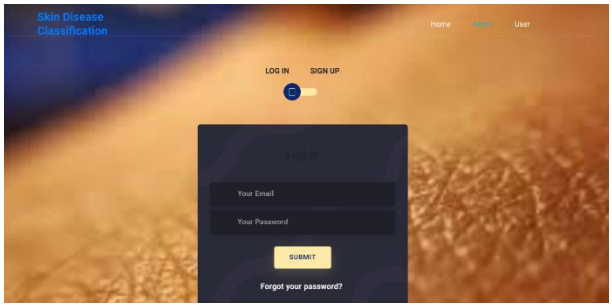
The following screenshots are depicted the flow and working process of project.

Home Page: In our project, we are classifying the presence of Skin Disease Classification, with the help of CNN and Transfer learning.

About Project: Here the user will get a breif idea about the project.

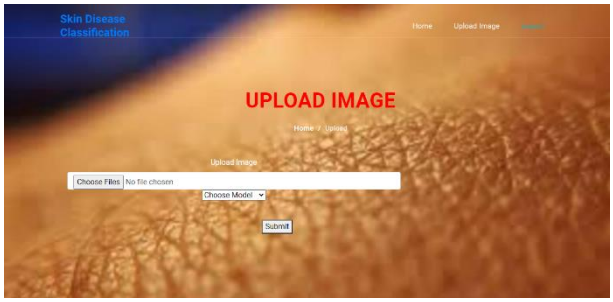


Login page: This is the page where user can get login with registered credentials.



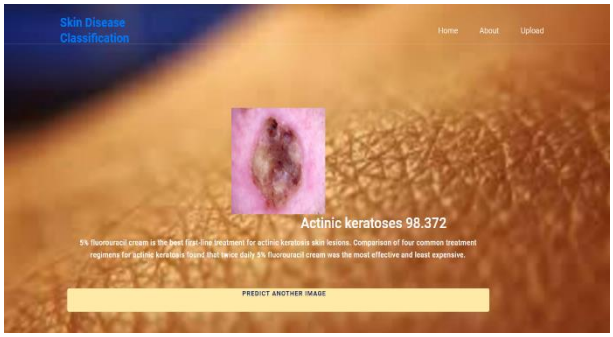
User Home: Once after successful login user can view the home page.

Image Upload Page: Here the user can upload the image of skin which is having the disease. To know the disease name.

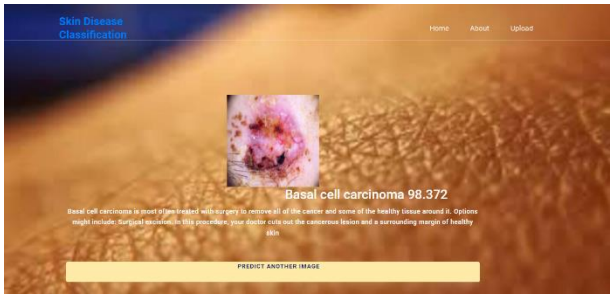


Once after user uploaded the skin image model prediction will be done and the user will get the classified disease for his/her uploaded image. The classification of the skin disease are as follows.

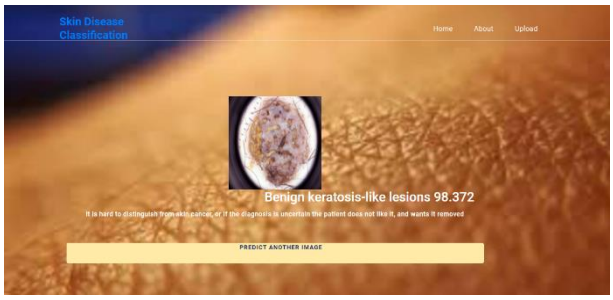
Actinic keratosis Image:



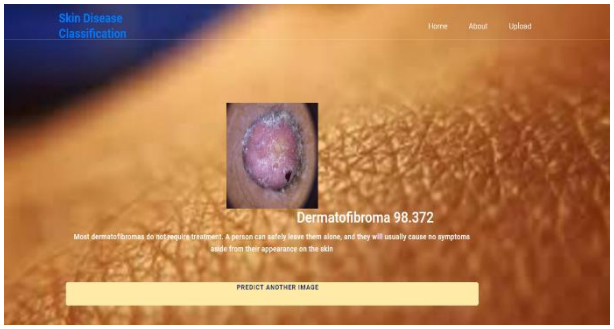
Basal cell carcinoma:



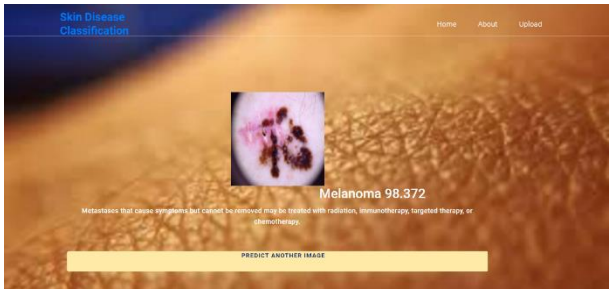
Benign keratosis-like lesions:



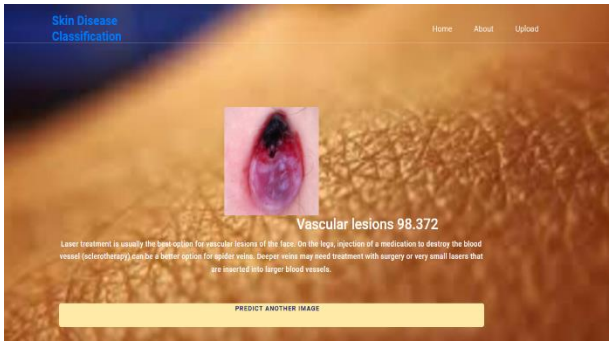
Dermatofibroma:



Melanoma:



Vascular lesions:



IV. CONCLUSION

In this project we have successfully classified the images of Identification of Skin Diseases, are affected with the using the deep learning and Transfer learning. Here, we have considered the dataset of ham10000 images which will be of different types Diseases and trained using CNN along with some ResNet50 transfer learning method. After the training we have tested by uploading the image and classified it.

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