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Dermatitis Stratification and Cancer prognostication with diet pyramid Using Machine Learning

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Abstract

This research paper gives an overview of our project. In this project, we are developing a 2 model using a machine-learning algorithm. First Model :- It takes an image as input and predict which type of skin disease it is and what foods are to be avoided and taken for . We have used the Dataset of most common 7 types of skin diseases(contains about 3000 sample Images of 7 classes of most for feature extraction from input images and then ANN is used for the classification.

Second Model :- It also takes the image as input and predict weather it is Cancerous or Non- Cancerous or Pre-Cancerous skin diseases. We have use ISIC datasets which has 7 class types . out of the seven classes One class is Pre-Cancerous , 3 classes belongs to Cancerous and remaining 3 classes belongs to Non-Cancerous skin diseases. For this Model we are using CNN (our own Custom Model Architecture) , ANN and Different Image Processing Machine Learning Algorithm and Libraries.

Keywords:-CNN,ANN, Machine Learning, Transfer Learning

common skin diseases disease). CNN Algorithm(we are using Transfer Learning) is used

Introduction

Skin disease has been one of the major problems that have been faced by people in the world. Skin disease is still found in almost every part of the world. According to According to the Global Burden of Disease project, skin conditions remain the fourth-most common cause of nonfatal disease burden globally. It is very much dangerous if it's not diagnosed at an early stage of the time. The problem of skin disease has been there from an early time which has caused a devastating effect on the life of people. So early diagnosis is very much important. Skin disease is very difficult to analyze and detect. It can only be performed in the laboratory. So we have proposed a model that can identify the type of skin disease and aware people at the early stage. So that the problem can be diagnosed at an early stage without having its diverse effect if not diagnosed properly.

Our model has taken the Data Sets of Most Common types of Skin diseases dataset which consists of 3000 images of the 7 classes of skin disease. The picture taken will be compared with the given datasets using Convolution Neural Network(CNN) and Artificial Neural Network(ANN) to compare the input image with the dataset and provide the most similar output to the user.

In Rural areas, people are not getting proper treatment and they are lacking technology and laboratories at that areas.

Mild acne typically manifests as whiteheads or blackheads, which are small, non-inflammatory bumps that develop when clogged pores by excessive oil, dead skin cells, and germs. Whiteheads appear as small, raised bumps with a white or yellowish head, while blackheads look like small, dark dots on the surface of the skin.

Moderate to severe acne can appear as inflamed, red, and painful pimples, nodules, or cysts. Pimples are typically small, raised, and red or pink with a white or yellow center, while nodules and cysts are larger, deeper bumps that can be painful to the touch.

Anywhere on the body can have alopecia areata, but the scalp is where it most frequently manifests. On the scalp, the condition usually manifests as smooth, rounded patches of hair loss that can range in size from tiny coin-sized spots to bigger expanses.

The affected area may appear red and inflamed, and there may be some scaling or mild itching. In some cases, there may be hair regrowth within the affected area, but this can be patchy and unpredictable.

Eczema is a skin condition that can cause redness, itchiness, and inflammation. The appearance of eczema can vary depending on the severity and type of the condition. In general, eczema often appears as dry, scaly patches on the skin, which can be red or brownish-gray in color. These patches may be raised or flat and can be quite itchy, especially if they are located in areas where clothing or jewelry rubs against the skin.

In some cases, eczema may also cause small, fluid-filled blisters that can ooze or crust over..Psoriasis is a chronic skin condition characterized by patches of thick, red, and scaly skin. These patches, also known as plaques, are usually silver or white in color and can appear anywhere on the body.

Rosacea is a chronic skin condition that typically affects the face, causing redness, flushing, and sometimes small, pus-filled bumps or pimples Visible blood vessels: In some cases, rosacea can cause small blood vessels to become visible on the surface of the skin, giving the skin a spidery, web-like appearance.

Bump and pimple: Some rosacea sufferers get little, red bumps or pus-filled pimples on the parts of their face that are afflicted.

A chronic skin disorder called vitiligo results in regions of the skin losing their pigment. Vitiligo can have a wide range of appearances, however some frequent characteristics include:

Depigmented patches: The emergence of white or light-colored patches on the skin is the most typical symptom of vitiligo. These blotches can arise anywhere on the body, whether they are small or huge..

Symmetrical patterns: In many cases, vitiligo patches appear in a symmetrical pattern, meaning that they occur on both sides of the body in similar locations.

Rapidly changing patches: The size and location of vitiligo patches can change rapidly and unpredictably.

White or gray hair: Vitiligo can cause the hair in the affected areas to turn white or gray.Sunburn-like appearance: In some cases, the skin in the affected areas may appear red or sunburned.

Skin Cancer :Changes in skin texture: Skin cancer may cause the skin to become rough or scaly, with a texture that may resemble sandpaper.

Changes in the size or shape of moles: Skin cancer can cause existing moles to change in size, shape, or color, or it can cause new moles to appear.

Irregular borders: Cancerous moles or lesions may have irregular, scalloped, or poorly defined borders.

Changes in color: Skin cancer can cause moles or lesions to become darker or lighter in color, or it can cause them to have multiple colors or shades.

Itching or bleeding: Skin cancer may cause moles or lesions to itch, bleed, or become tender. These are the 7 classes of skin cancer lesions that are included in our dataset and by using our own designed model DCNN and ANN the dataset is being trained and classified into various kinds of disease.

Related Work

Many Other researchers have worked on the detection and analysis of skin disease. Many of the models work under imaging technology and do not require radiology technology to determine the type of disease. They can detect the condition based on the image using different types of algorithms like CNN ANN or deep learning. These are some of the work performed by the researchers to detect skin disease using different mechanisms:

Ibrahim Abunadi, et all(2021)[1] proposed research in which they included ISIC 2018 and PH2 data sets. They took the sample and compared it with the datasets and classify the result using LBP, GLCM, and DWT algorithms. And the deep feature maps were extracted using CNN for the ResNet-50 and Alex Net models. [1]

Bishwanath Reddy, et all(2021)[2] proposed a model to classify melonoma using CNN. In the model, the image is taken as the input. Then the number of features is extracted from the image using a training file. Then CNN algorithm is applied for both the training file and the tested input image for the detection of melanoma. Finally, the presence or absence of melanoma is determined using the CNN algorithm. [2]

V.Jaychandra Reddy, et all(2019)[3] proposed a model using ANN to determine the six common skin diseases in which they take a video or image format which is then processed with the pattern acknowledgment framework that will finally include the extraction and the classification of the image or the video content. [3]

Parvathaneni Naga Srinivasu, et all(2021)[4] proposed a model using deep learning neural network model to determine the disease. The model was integrated with the LSTM and MobileNet V2 which is used to classify the disease and by enhancing the performance of the model with the help of LSTM. The input image is categorized and then the image is compared with the previous datasets through training by LSTM and then the soft max determines the class of the disease [4]

Padmavathi S, et all(2020)[5] Proposed a model to determine Dermatological Disease which consists of 10015 Dermatoscopic image datasets categorized into different classes. In which the datasets are pre-processed by removing the crude information and the deep learning models use linear regression to choose the content that fits the best Then overfitting is used to choose the accurate prediction from within the datasets. [5]

T. Swapna, et al(2020)[6] model in which they have used a dataset that includesWarts Mollusca, Systemic disease, actinic keratosis, acne, rosacea, nevus, bullous, and seborrheic keratosis To identify skin conditions, a deep learning model is used. It will make use of numerous methodologies, analyse the data, and produce an output by connecting the image data with the many types of features that need to be anticipated. In this model at first, the input image is taken, and then using various kinds of algorithms lie CNN, Resnet alexnet, and inception v3 gives the output but the accuracy from Resnet When compared to other models, the models employed to predict and identify skin diseases had higher train and test accuracy. [6]

Kritika Sujay Rao, et al(2020)[7] model it had used a dataset based on Skin Cancer-MNISTModified National Institute of Standards and Technology Database)-HAM10000 they used a convolution neural network 2d layer and it has used thirty-two filters and each filter transform a small part of the image defined by specific kernel size using kernel filter and then the images which are transformed are the filter maps used in this model. The most important layer used in this model is the pooling layer which acts as a sampling filter inside the pooling layer there is max pooling which picks the maximal worth among the all set of two neighboring pixels. combing both convolution and pooling layer CNN gets all the features required. To convert all the final feature which is mapped into a single One-dimensional vector it needs to be flattened using Flatten layer and by using the dense() it is used to give the net output.[7]

Padmavathi S, et al(2020)[8] It has used a different data set which is 10015 dermatoscopic for their model by using the CNN architecture the output is given but the accuracy was low compared to others. It has also used the linear regression algorithm for a set of functions and chooses the most fitted one. But the model proposed by Leelavathy S, Jaichandran R (4) detects different kinds of skin diseases like Psoriasis, Lichen Planus, Pityriasis Rosea. which is a different kind of skin but has used the same algorithm that is CNN.[8]

Proposed System

Our proposed methodology is an effective tool that will help people input images containing skin diseases to predict the seven types of skin diseases. After the image pre-processing, the feature is getting extracted using CNN architecture.

Convolution Neural Network (CNN)

Fig.1 Show CNN architecture, that can learn directly from the data rather than from manual feature extraction. CNN is mainly useful to find Using patterns in photos, one can identify scenes, faces, and objects. Additionally, they can be utilized to categorize non-image data, including audio, video, and signal data. It consists of a different layer. Where the input layers take the input as an image then it passes to the hidden layer or the Convolution layer which detects the patterns from the image and then passed to the output layer.

Convolution :- Through a layer of convolution filters, it removes certain characteristics from the picture.

Relu :- By mapping the negative value as zero and keeping the positive values, it enables quicker training. The active characteristics in this are passed over to the next layer.

Pooling:- By lowering the number of parameters the network needs to learn, it simplifies the output.

Here we are using Transfer Learning for CNN part . We are using VGG19 for feature extraction . Transfer Learning means using already Trained Model.

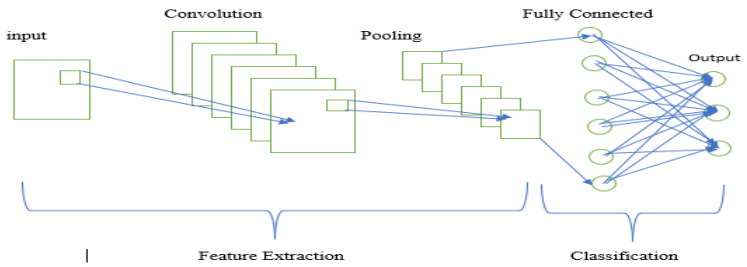


Fig 1:- Convolution Neural Network

Artificial Neural Network(ANN)

Fig.2 indicates ANN(Artificial Neural Network) which we used as a classifier. As ANN is the computational model that works according to the nerve of the human brain. It consists of 3 or more layers that are interconnected to each other. Where the outer layer consists of the input neuron which sends data to the inner neuron for the process of producing. The unit that transfers the information from layer to layer through a series of transformations creates all the inner layers, which are all hidden. In order for the ANN to comprehend more complicated things, each layer functions as an input and output layer.

By weighing the input in accordance with the internal system, the neural layer's unit strives to understand the information gathered better. Backpropagation is used to adjust the output based on the error that occurred. When the error is labeled in the output it is back propagated and the To determine how much of the error creation they are responsible for, weight is updated. In order to determine the difference between the desired output and the actual output, the error is calibrated to the weight. ANN can learn from observing the datasets so it is cost-effective and can easily predict the solutions while defining the computing function. It enhances the data analysis technologies cause it takes samples other than the whole data.

Here ANN is our custom model that we merged with trained CNN architecture of VGG19. So after the classification of the type of skin diseases which are ('Acne' ,'Alopecia_areata','Eczemaa','Psoriasis','Rosacea','Skin_Cancer','vitiligo')

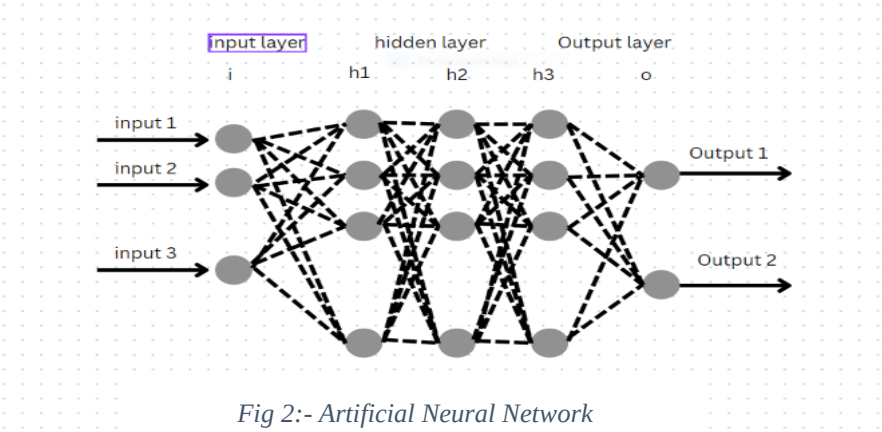


Fig 2:- Artificial Neural Network

OPENCV:

It use image segmentation techniques to isolate the skin lesion from the surrounding skin. This is done using various cv2 functions, such as thresholding, edge detection, or color-based segmentation. Where it creates a binary image where the skin lesion is represented by white pixels and the surrounding skin is represented by black pixels. Once the skin lesion is isolated, various features can be extracted from the image using cv2 functions, such as texture analysis, color analysis, or shape analysis. These features can be used to characterize the appearance of the skin lesion and differentiate between different types of skin cancer. Finally, the extracted features can be used to train a machine learning algorithm to predict the presence or absence of a skin cancer in a new image.

Adams Optimizer:

Adam optimizer is a popular stochastic gradient descent optimization algorithm commonly used in deep learning applications, including skin cancer prediction. It train a deep learning model, such using a Convolutional Neural Network (CNN), to foretell whether a skin condition would be present or absent in a fresh photograph. The loss function—a gauge of how effectively the model can predict the right label for each image in the training set—is minimized during training using the Adam optimizer. The model can be tested on a different collection of photos after it has been taught to assess its performance. Metrics like accuracy, precision, and recall are frequently used to gauge the model's performance.

Flowchart

Fig.3 explain all the experiment which we perform for skin disease detection using image processing. In this model that we proposed at first the user takes an image of affected areas which will be going through various kinds of image per-processing techniques like feature extraction using CNN(Using VGG19's CNN Architecture -> Transfer Learning) to predict the skin disease.

Our proposed methodology is an effective tool that will help people input images containing skin diseases to predict the seven types of skin diseases. After the image pre-processing the feature is getting extracted using CNN architecture.

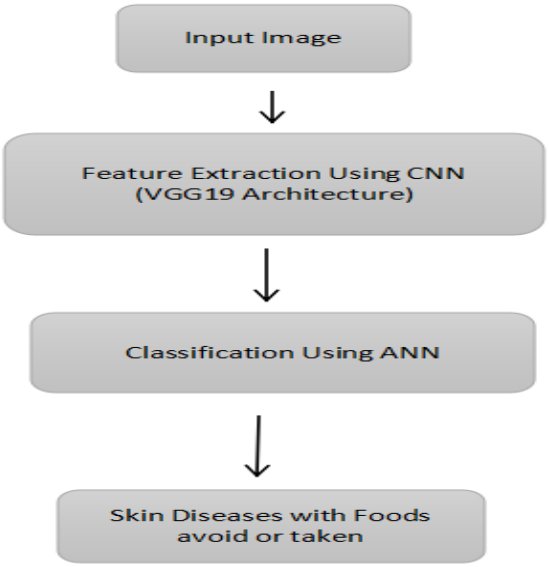


Fig 3: Working of stratification model

Architecture

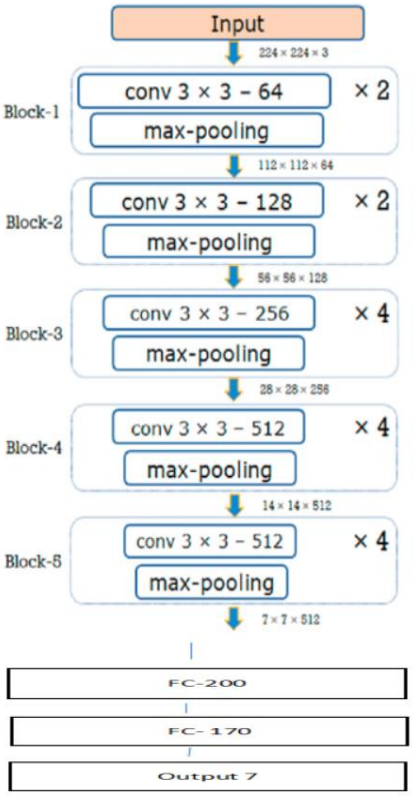


Fig 4: Block diagram of Stratification model

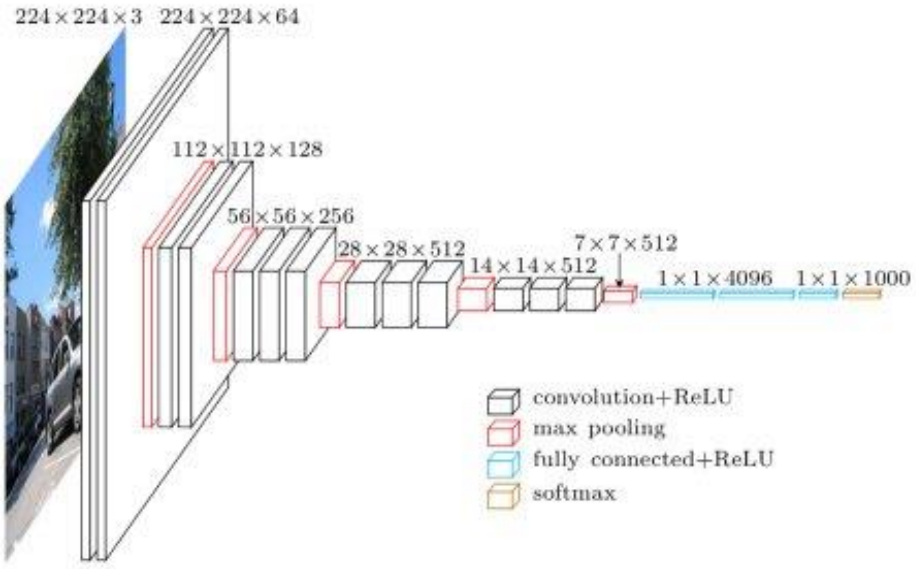


Fig 5:-Architecture of Stratification Model

Fig.4 and Fig.5 explains the architecture that how the process is going on inside our model. At the initial stage, the image of size 180*180*3 is taken as input and passing it into the next layer which contains a 3*3 convolution filter with and width is 64 and a 2*2 max pool (which is the procedure that selects the maximum element from the region of the feature map covered by the filter). This method standardizes the input to one layer of each mini-batch when training a deep neural network. And Again image is passed to same kind of layer .After all the processes 112*112*64 size of the image is obtained as output. So then the image size which is obtained is taken as input and then it is transferred to the layer which contains a 3*3 convolution filter and width 128 with the same max pool and again pass to same kind of layers which gives the output as 56*56*128 and then image size 56*56*128 is taken and input and processed to another 2 layer containing same size convolution filter but with different width 256 and with same techniques like max pool, Then the image size 28*28*256 is obtained and it is passed into another layer. This pass through 4 layer contains a 3*3 convolution filter with a width of 512 and goes through the techniques like 2*2 max pool, result 28*28*512 is obtained which goes to the different 4 layer containing the same techniques and with result 14*14*512. Then this images is again pass through 4 layer contains a 3*3 convolution filter with a width of 512 and goes through the techniques like 2*2 max pool, result 7*7*512 is obtained

Then the output which is obtained is passed through the layer which contains ANN as a classifier(200 then 170) and obtained features ReLu is chosen as an activation function. The last layer, contains ANN as a classifier and uses softmax(which is used as the activation function in the output layer of neural network which predicts a multinomial probability distribution) and classifies seven types of skin disease and gives the output.

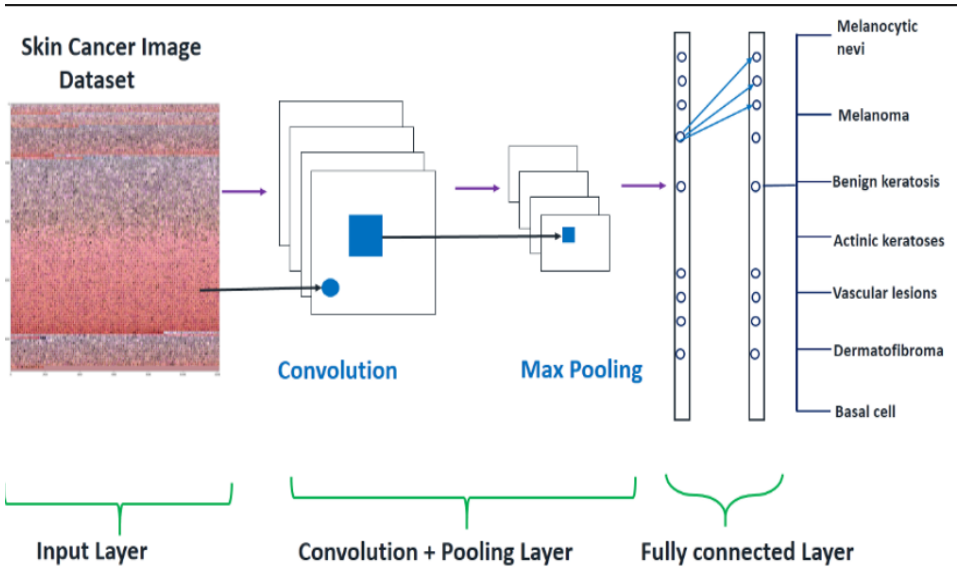


Fig 6:-Working of Prognostication model

The Given Fig shows the working model of skin Prognostication . the model takes input image and do image preprocessing . the Pre processed image passed through Convolution layer(Convolution + MAX Polling layer) for feature extraction . then extracted features are passed through full connected layer /ANN for classification .

And the train model predict the Cancerous , Non Cancerous and Precancerous skin diseases along with diet Pyramid.

The model take images input size of 28*28*3 pixels. This images are passed through Convolution layer of 3*3 kernel-size with 16 filters having relu as activation function with padding 'same' . then it is passed through Max Pool 2*2 layer and then passed to Batch Normalization.

The image obtain is again pass through Convolution Layer followed by MAX-Pooling and Batch Normalization Layer.

Then obtain images are passed through 2 Convolution Layer having filter size 128 and 256 respectively. The image features obtained from these convolution layer are flattened and 0.2 Drop Out is applied and then passed to fully Connected(fc)-256-Relu --> Batch Normalization layer --> Drop Out(0.2) layer --> fc-128 -Relu --> Batch Normalization layer --> fc-64 layer-Relu --> Batch Normalization layer -->DropOut(0.2) layer -->Batch Normalization layer . Then finally passed to fc-7 -Softmax layer .

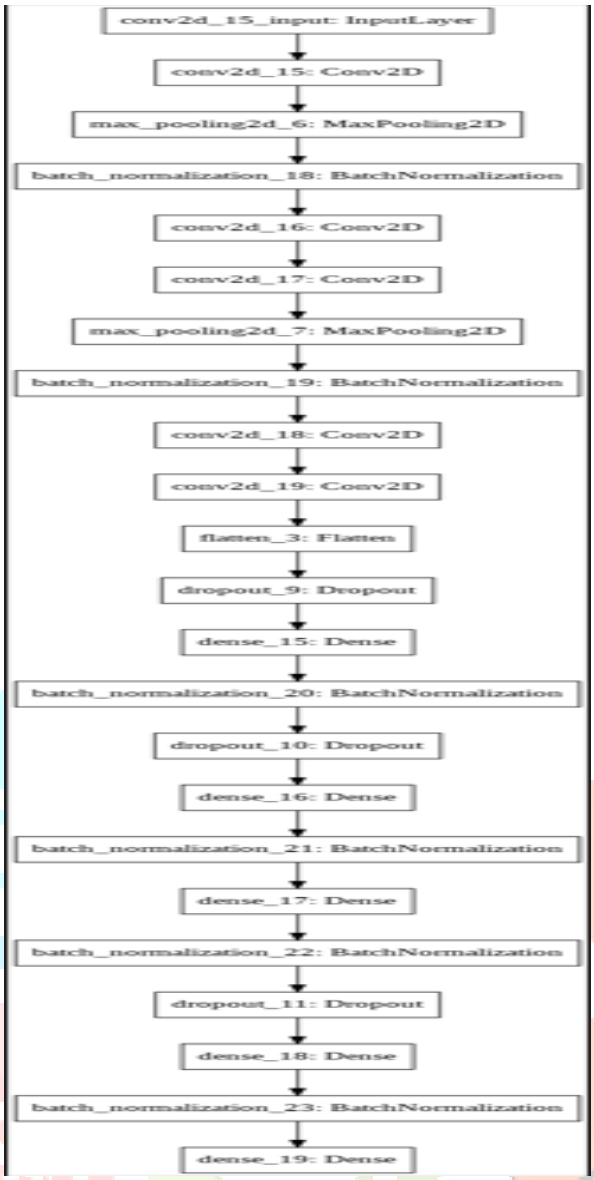


Fig 7:-Block of Prognostication model

Result and Discussion

Result of Stratification Model

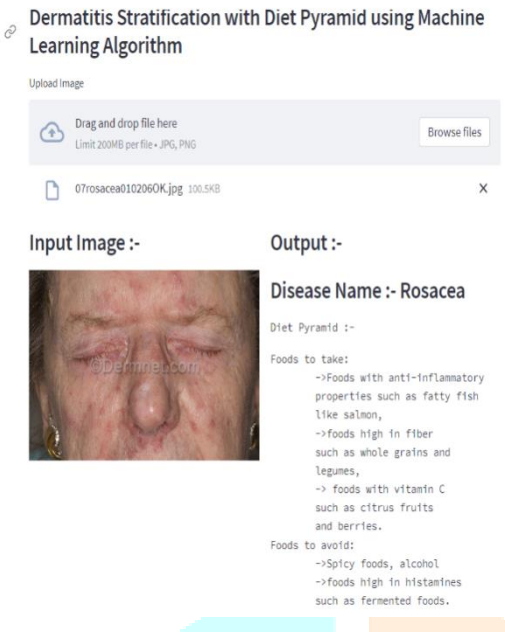


Figure 8:- Rosacea

Fig.6 indicates Rosacea.It is a chronic skin condition that typically affects the face, causing redness, flushing, and sometimes small, pus-filled bumps or pimples

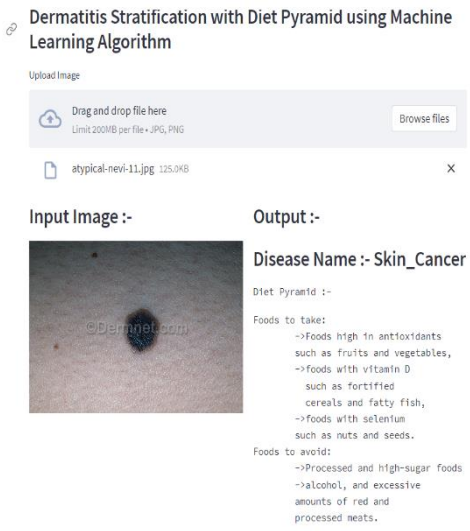


Figure9:-Skin Cancer

Fig.7 indicates Skin cancer may cause the skin to become rough or scaly, with a texture that may

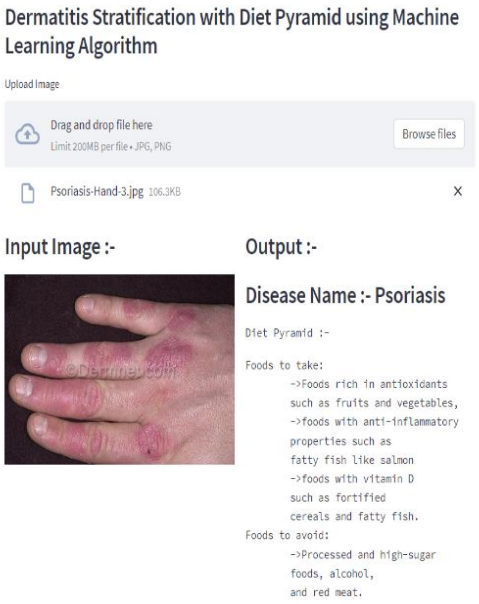


Figure 10:- Psoriasis

Fig.8 predicts Psoriasis. Patches of thick, flaming, and scaly skin are the hallmarks of this persistent skin disorder. These spots, also known as plaques, can develop anywhere on the body and are often silver or white in colour..

Figure 11:- Acne

Fig.9 indicates Acne .It is a skin condition that typically appears as inflamed, reddish bumps or pimples on the face, neck, chest, shoulders, or back. The appearance of acne can vary depending on its severity and type.

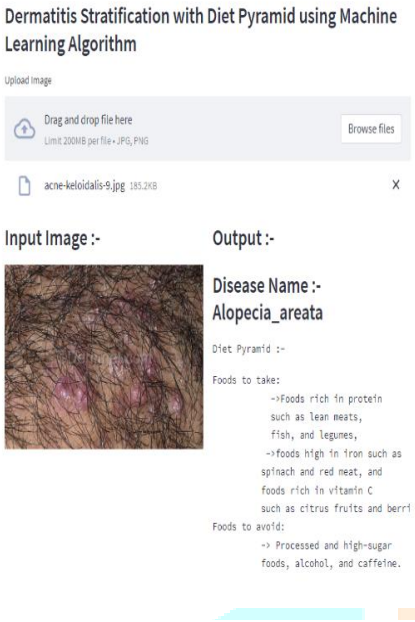


Figure 12:- Alopecia areata

Fig-10 indicates Alopecia areata. It is a type of hair loss that can happen everywhere on the body, but the scalp is where it is most frequently encountered. On the scalp, the condition usually manifests as smooth, rounded patches of hair loss that can range in size from tiny coin-sized spots to bigger expanses.

Figure 13:- Eczema

Fig 11 indicates Eczema. It is a skin ailment that can lead to irritation, itching, and redness. Depending on the nature and severity of the ailment, eczema can have a variety of appearances.

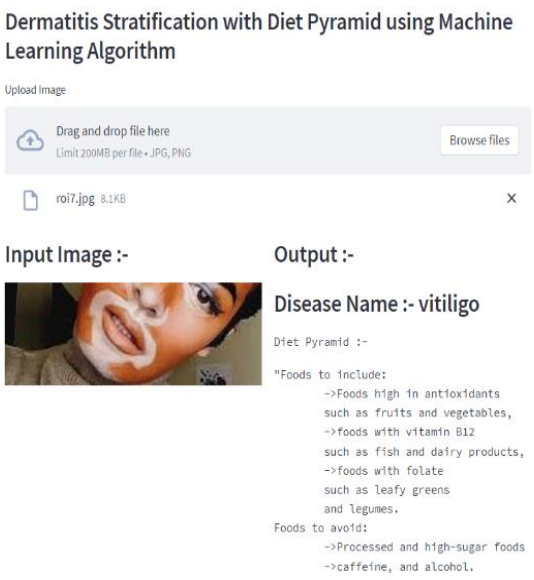


Fig 14:- Vitiligo

Fig:12 indicates Vitiligo It is a chronic skin disorder that results in regions of the skin losing their colour. Depending on the individual, vitiligo can have a very different appearance.

Result of Prognostication Model

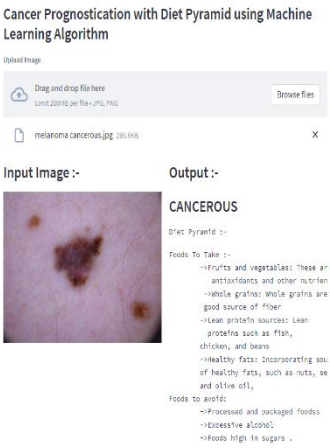


Fig 15:-Cancerous

: It can be determined by the specific feature which looks like scaly, crusted or wart-like lesion on the skin that appear as firm, red bumps or as flat, scaly, reddish patches.It can be determined by the specific feature which looks like scaly, crusted or wart-like lesion on the skin that appear as firm, red bumps or as flat, scaly, reddish patches.

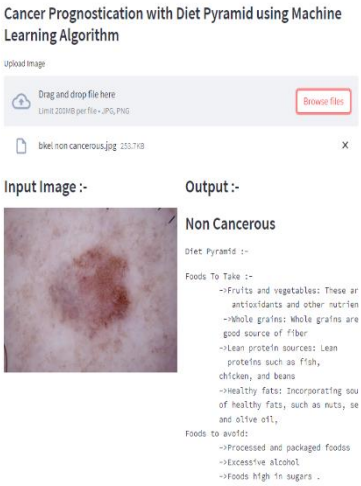


Fig 17:-Non Cancerous

It can be determined by presence of a well-demarcated, slightly raised or flat lesion with a rough surface that looks "pasted on" the skin which looks like light tan to dark brown or black

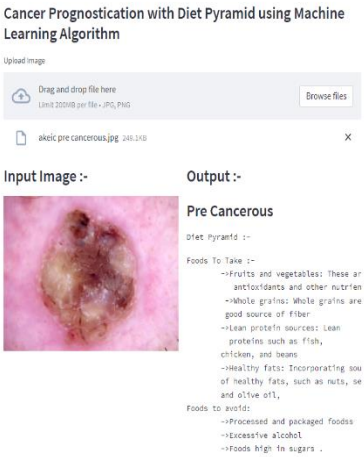
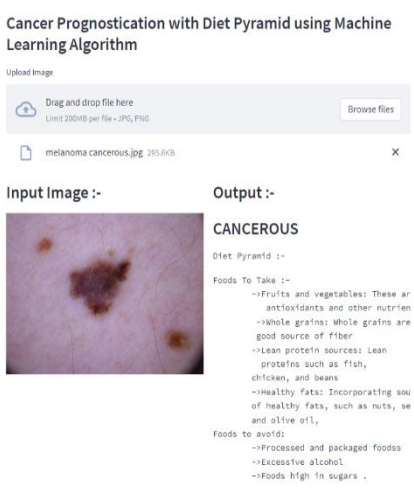
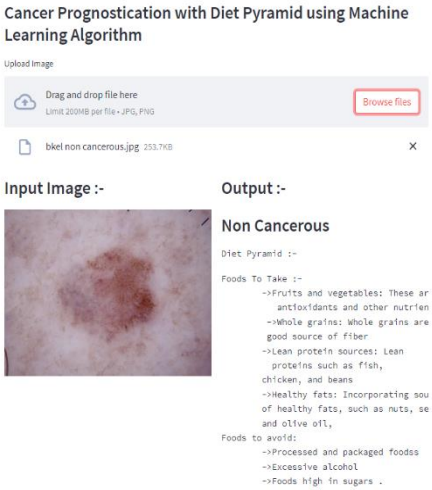


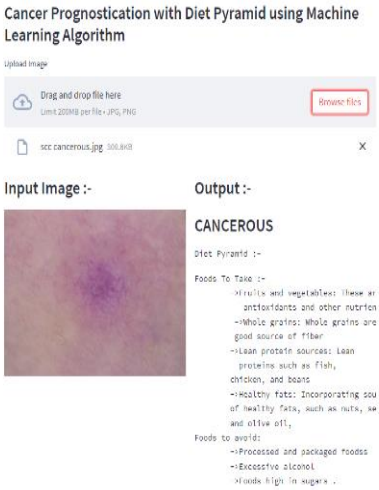
Fig 16:-Pre Cancerous

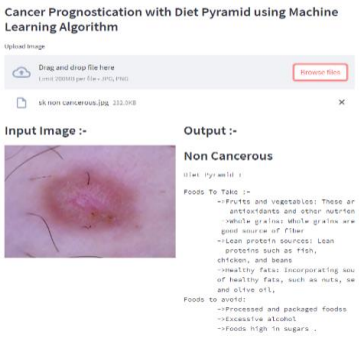
It can be determined by the presence of scaly or rough patches of skin on sun-exposed areas, such as the face, scalp, ears, and back of the hands that may be pink, red, or brown in color. They can range in size from a few millimeters to several centimeters.

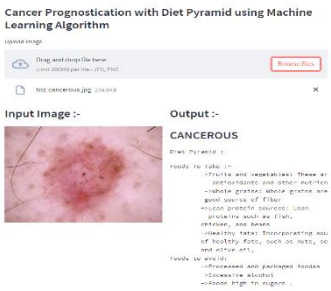
Sample Images

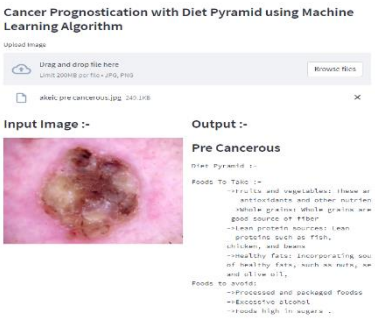












ACCURACY

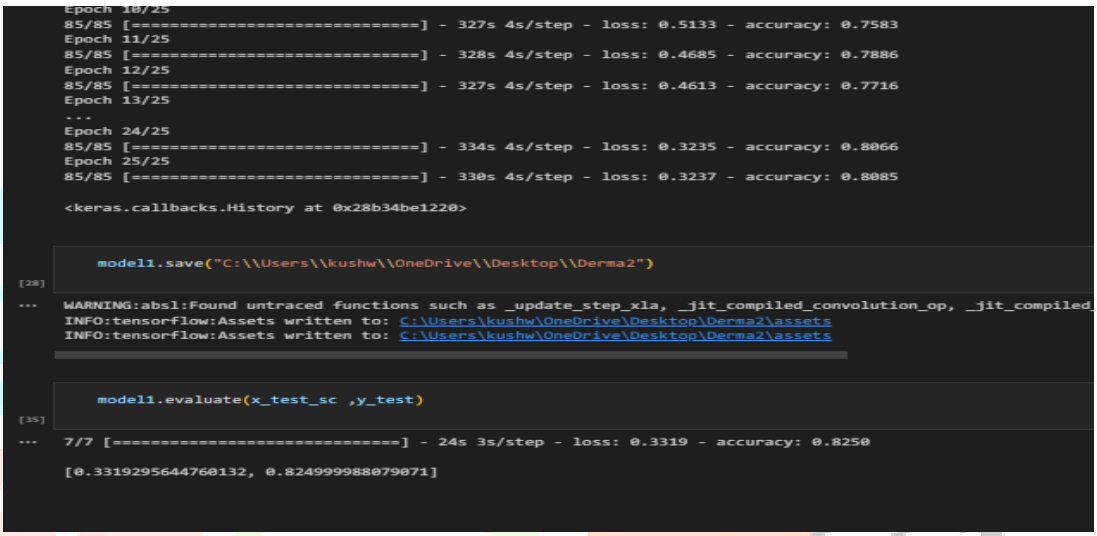


Fig.18:-Accuracy of Stratification Model

Fig 18 indicates the accuracy to be 82.5% after the model is trained.

The above figures explained that the system will accept the user-given or input images in the user interface which is designed with the help of the python library Stream Lit. It explains that as the user provides the skin disease images then image pre-processing and machine learning algorithm is being performed at the backend.

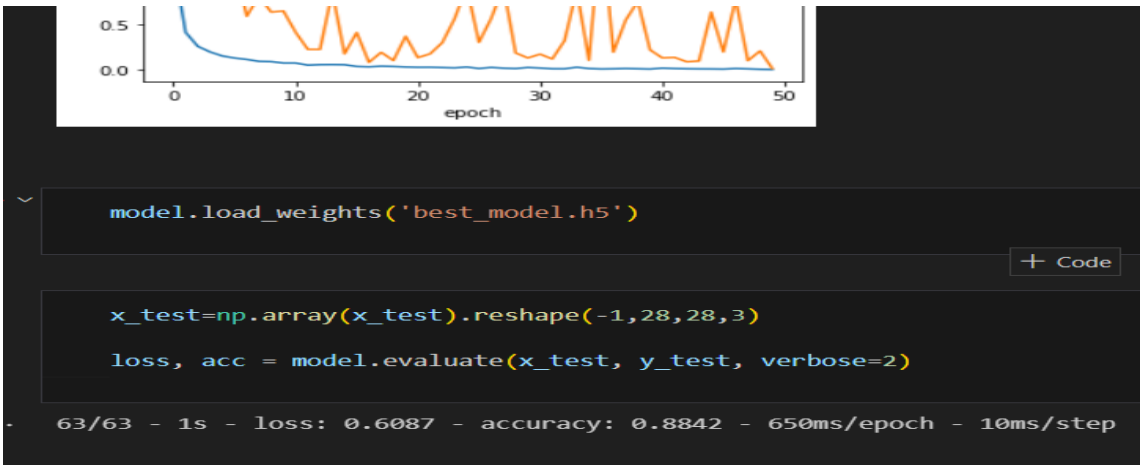


Fig 19:-Accuracy of Prognostication Model

Fig:19 indicates the accuracy of the Prognostication model which is found to be 88%

Conclusion

The suggested model uses CNN (Convolutional Neural Network) and ANN (Artificial Neural Network) to detect seven different forms of skin diseases.. It is more useful in the area where there is a lack of hospitals and laboratories so that people can get the prior information if have a skin problem and can diagnose at the exact time. The model is free of cost and does not require any kind of subscription so can be accessible to all kinds of people.

Future Extension

As our model is applied to the health care system. The primary aim to make this model was to help in places where health care systems are not so built to make it simple to identify the type of skin illness using our model. In the future, the model's accuracy will also increase.. As of now it only detects seven types of diseases but in the future, we are planning to include almost every kind of cancerous and non-cancerous kind of skin disease.

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