DEEP LEARNING-BASED SKIN DISEASE DETECTION

BY

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This Report Presented in Partial Fulfillment of the Requirements for the Degree of Bachelor of Science in Computer Science and Engineering

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APPROVAL

This Project titled "**Deep learning-based skin disease detection**", submitted by Rahid Hossain to the Department of Computer Science and Engineering, Daffodil International University, has been accepted as satisfactory for the partial fulfillment of the requirements for the degree of B.Sc. in Computer Science and Engineering and approved as to its style and contents. The presentation has been held on 16–07-2024.

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DECLARATION

We hereby declare that, this project has been done by us under the supervision of **Saiful Islam, Assistant Professor, Department of CSE** Daffodil International University. We also declare that neither this project nor any part of this project has been submitted elsewhere for award of any degree or diploma.

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ABSTRACT

Skin diseases are more common than other disease in Bangladesh. Skin diseases may be caused by fungal infection, bacteria, hot weather, allergy, or viruses, etc. The thesis paper on skin disease detection focuses on the application of advanced technologies, specifically artificial intelligence and machine learning, for the early and accurate identification of various skin conditions. The research involves the acquisition of skin images through diverse sources such as smartphones, cameras, or specialized devices. These images undergo a systematic process, including image preprocessing, feature extraction, and classification, facilitated by sophisticated algorithms. There are various types of algorithm which using in disease detection method. This algorithm is, Convolutional Neural Networks (CNN), Support Vector Machines (SVM), Random Forest (RF), Transfer Learning (Pre-trained CNNs), K-Nearest Neighbors (KNN), Feature Extraction Techniques (e.g., HOG, GLCM, LBP) and Recurrent Neural Networks (RNNs). Determining the "best" algorithm for skin disease detection depends on various factors, including the nature of the dataset, the specific skin conditions targeted, and the characteristics of the images involved. Normally we decide to use CNN algorithm because of, CNNs offer many advantages for skin disease detection, it's essential to consider the specific requirements and constraints of the application when choosing an algorithm. The proposed CNN architecture is based on VGG-16 and will be trained and tested on datasets collected from skin disease. The goal is to create a reliable and non-invasive method for diagnosing skin conditions, with potential applications in both self-assessment tools for users and remote consultations with healthcare professionals.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

That division of the living soul structure, that are the skin carrying capillary, shivers and energy that sweat determine outside climate. It shields our structure from numerous infections microscopic organisms that us come across in our daily life. It also sits away from the rays of the sun, rarely bright that can exfoliate cells from the human body, but can cause equally huge problems with the accumulation of skin disorders like acne, scabies, pyodermas, etc. It is observed at approximately 72 Three percent of men and 58.8 percent of women in Japan have tried SNS dating, making it the second most used dating site in the country. According to the overall cost of various skin diseases and hence, have to pay hefty fees and visit the doctor's office. However, with the help of neural network methods, it is possible to distinguish which skin diseases the deceased were suffering from. Identifying and evaluating skin infections is another basic measure for creating a safe rebound existence, we recommend doing. This research paper, us discover an automatic function integrated with a mobilized version approach this aims to help people obtain precise details about their skin using their smart mobile phone or web browser. The first method involves capturing an image of the affected skin site, then storing the image in the circuit. The image of the transferred affected skin locale will be evaluated on the central server and addressed with the skin title if it corresponds to the four diseases from which it was generated.[1]

1.2 Motivation

People today are more civilized than people of older generations. These are inventions that surround us in life to simplify our experience. We can shed so much light on the lots of syndicate that we face in our regular life. Now and again, using advances like artificial intelligence and machine learning, it is possible to find such problems very easily and effectively. Subsequently, such at-risk individuals may proceed with specialists for additional treatment. In addition, as a parcel of 280 cubic meters it can be very meaningless, for example, for some people cannot mean the purpose of a house. Experts to encourage

treatment. However, this can be extremely useless as a parcel of that cure is already on the internet. Today's health care system appears to be more expensive while treatment is readily available, making it difficult to secure such ventures as boring for remedies that contrast trivially with the cost of a great dermatologist's system. Although a significant lion's share of the population suffers from one form of skin infection or another, substantial or trivial, most of those individuals are exceptionally reluctant to seek treatment and will likely never visit a doctor. When the situation deteriorates to a point where their life is truly miserable, the last resort is specialists with high therapeutic value and pain. Whether it is air pollution or the need for legitimate cleanliness, Bangladesh has become an essential way of people's lives as a progressive country requiring clean pollution. There is no proper and proper well-functioning office for the public to contact for help. The gravity of the situation is however experienced by the victims, who sustain themselves and endure day to day, conducting their business. Boffo Bolster's cache for Medicare is acquired by most scammers without an expert to masquerade them.

Programming languages and associated libraries have therefore helped us make progress in understanding how to interface with other humans. Among the various products of computer vision that underlies it, image processing can be referred to as belonging to the AI and ML categories. With the help offered by such innovations, we have been able to create a "neural network" that helps us think about different images of skin infections and provide feedback such as their classification. Problems can be managed with the help of incremental offer innovation. Through accurate detection of skin infections, individuals can know their infections at a personal level and subsequently empower them to consider valid restoratives. A more productive population, work class, partner and family will contribute more to environment of few terms and thrive of big terms.

1.4 Research questions

- What the cause of influenced individuals is hesitant to move for remedy?
- Find out of main facilities of organize way in detection of skin disease?

1.5 Output

- Recognizable proof suitable sickness
- Decrease of circulate and developing maladies
- Reduced good health service costs
- Extra assist in diagnostic field

1.6 Report layout

Our thesis report is organized as follows:

- Chapter One includes an introduction to our project, motivation, research questions, and expected outcome.
- Chapter Two includes Background, related works. Research summary, and challenges.
- Chapter Three includes Research Methodology.
- Chapter Four includes Experimental results and discussion.
- Chapter Five includes Impact on society, Environment and Sustainability.
- Chapter Six includes Summary and Conclusion it's all about experimental result and discussion.

CHAPTER 2

BACKGROUND

2.1 Introduction

So, this world, various of the skin infection affecting people due to negligence, lack of proper behavior, climate change, poisonous food and sheer bad luck. Skin infections above do not even distinguish people by their age. It is worth noting that skin infection can involve a small child or an exceptionally older people. Skin infection can be happened significant trouble that interrupts the person's daily life. So, that are not difficult for one from suffer to skin infection, but that are not easy to determine which skin infection are involve us and how they can be treated. Today we can identify a large number of skin diseases that affect people throughout the land. Among them skin infection is dermatitis, cellulitis, impetigo, athlete's foot, nail fungus, ringworm, larva migrans and so on. This paper focuses on eight skin diseases to perform machine vision based malady recognition based on visible side effects of skin diseases. Namely, cellulitis, impetigo, athlete's foot, nail fungus, ringworm, larva migrans.[2]

2.1.1 Cellulitis

Cellulitis is a bacterial contamination in the more profound layers of skin and the fat and delicate tissue underneath. Side effects can incorporate skin discoloration, swelling, and delicacy. An individual may require anti-microbials for cellulitis. There are around 14.5 millionTrusted Source cases of cellulitis each year in the Joined together States. Some microbes are normally show on the skin and do not more often than not cause hurt. Be that as it may, if they enter the skin, a contamination can result. Microbes can enter the skin through cuts, touches, or bites. Cellulitis is not the same as cellulite, a safe "orange peel" impact that can show up on the upper arms and thighs. Output picture showed in Figure 2.1.1

Symptoms: Signs and symptoms of cellulitis can vary depending on the condition. Such as:

- Discoloraiton and swelling
- Warmth

- Tenderness and pain

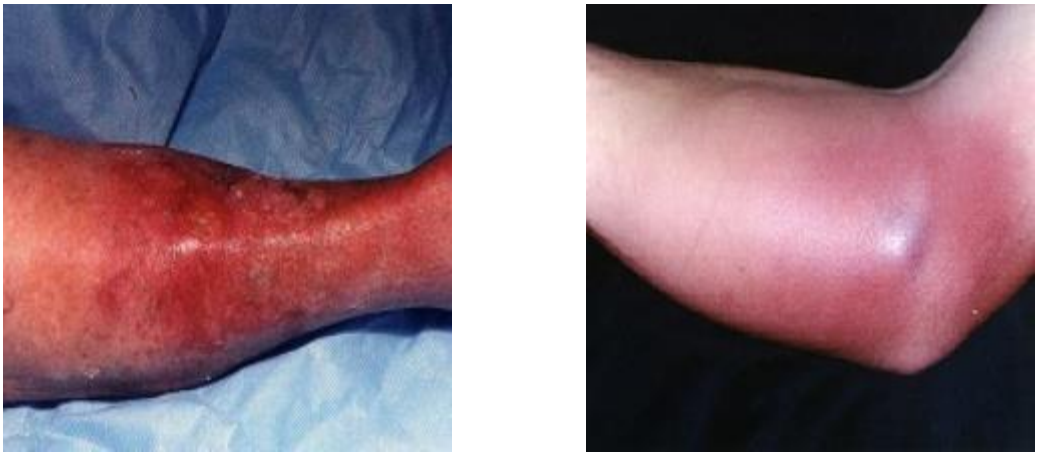


Figure 2.1.1: Cellulitis

2.1.2 Impetigo

Impetigo is a bacterial contamination that influences your skin, causing bruises and rankles. It can show up in an unexpected way depending on the arrange of disease and what portion of your body it affects. Impetigo is the most common bacterial skin infection that affects the skin in specific areas of the body. Bacteria such as Staphylococcus aureus or Streptococcus pyogenes contaminate the outer surface layers of the skin, known as the epidermis. The limbs, particularly the arms, face, and legs, are the components most commonly involved. No one is destitute, nevertheless, it is most inclined to injure children; This is of immediate significance for children aged 2 to 5 years. The contamination regularly starts in minor cuts, creepy crawly chomps, or a hasty such as skin inflammation — any put where your skin is broken. But it can too happen on sound skin. Output picture showed in Figure 2.1.2

Symptoms: Signs and symptoms of Impetigo can vary depending on the condition. Such as:

- Cold sores
- Ringworm
- Erysipelas
- Eczema

Figure 2.1.2: Impetigo

2.1.3 Athlete Foot

Tinea pedis or as generally referred to as athlete's foot is an infectious skin disease that impacts on the skin of their feet. It can moreover affect the toenails as well as the hands. Physicians refer to the contagious contamination as athlete's foot since they consider it widely seen among athletes. It is not a real illness, still once in a while it is complicated to cure athlete's foot. Athlete's foot is awful for diabetics or people who have an imperilled resistant structure; if you consider this, you ought to call your essential thought specialist at once. It is described in figure 2.1.3 below; Output picture Global knowledge engineering and management.

Symptoms: Signs and symptoms of Athlete's foot can vary depending on the condition. Such as:

- The aforementioned signs and symptoms include itching, stinging, and burning between your toes or on soles of your feet.
- Itching feeling on your feet and they are oppressed by blisters.
- This condition presents as cracked and peeled skin on the toes, floor of the foot and sometimes on the dorsum of the foot.
- Cracking of skin on the bottom part or the sides of the feet

Figure 2.1.3: Tenia Pedis

2.1.4 Nail Fungus

Onychomycosis is a fungal infection of the nails. The condition begins as a white or yellowish-brown tone under the fingernails or toenails. As the parasitic contamination goes deeper, the nail may change color, thicken and even begin to break at the edges. Nail organisms can migrate to several nails. If your condition is mild and you are not uncomfortable, you may not seek treatment. If your nail fungus is painful and your nail thickens, there are other things you can do, including medication. But if they treatment is really effective, the struggling nail organism regularly returns. Nail fungus is called onychomycosis. When the organism enters the cracks between your toes and the outer sole, the infection is known as athlete's foot or tinea pedis.

Output picture showed in Figure 2.1.4

Symptoms: Signs and symptoms of Nail organism can vary depending on the condition. Such as:

- Thickened
- Misshapen
- Discolored Brittle
- Crumbly or ragged

Figure 2.1.4: Nail Fungus

2.1.5 Ringworm

Ringworm is also known as tinea or dermatophytosis and is one of the most common parasitic skin diseases that have virtually no connection with worms. Ringworm is a name for this condition because it causes an annoying, flushed circular or a ring-shaped rash, as described by the CDC. It can occur virtually anywhere in the body and has different names based on which part of the body it affects.

The output image is shown in Figure 2. 1. 5

Symptoms: As with other diseases, there are conditions that will manifest shingles in humans including symptoms such as; For example:

- Itching
- Skin rash, itching, redness, or scaling, and rough, cracked skin.
- A ring-shaped rash
- Wearing hair

Figure 2.1.5: Ringworm

2.1.6 Larva Migrans

Larva migrans refers to a disease that affects humans by the migration of immature worms into body tissues. Multiple species of worms may be involved and peristalsis occurs in one of three modes. An infection in which the worms move just under the human skin is called cutaneous larva migrans.

The resulting image was displayed in Figure 2.1.6 below.

Symptoms: Signs and symptoms of Larva migrans can vary depending on the condition. Such as:

- Winding
- Threadlike
- Raised
- Reddish brown rash

Figure 2.1.6: Larva Migrans

2.1.7 Chickenpox

Chickenpox, also called chicken pox or varicella, is an acute infectious illness caused by primary infection with the varicella zoster virus, a member of the herpesvirus family. The disease causes skin manifestations that manifest themselves in rashes and the formation of vesicles that itch and turn into scabs.

The output image depicted in Figure 2. 1. 7

Symptoms: Signs and symptoms of Chickenpox can vary depending on the condition. Such as:

- Red and bumpy rash
- Fluid-filled blistered rash
- When the blisters scab over

Figure 2.1.7: Chickenpox

2.1.8 Shingles

Shingles is a viral disease that causes the area of the skin where it is located to feel painful with a burning sensation of the skin. The rash may be red, slightly pink/brown/dark brown or purple depending on skin color and may develop on one side of the body.
An output image was also generated and is presented in Figure 2.1.8 below.

Symptoms: Signs and symptoms of Shingles can vary depending on the condition. Such as:

- Fever
- Chills
- Headache
- Fatigue
- Muscle weakness

Figure 2.1.8: Shingles

2.2 Related works

The domain of medicine is particularly the recognition of diseases which in the long run save millions of lives with vision mastered over a long period of time in the ultimate part. However, there are not many simple reliable options that provide a convenient solution that talks about skin diseases from an image analysis.[1] A chemical approach to classify atopic dermatitis, psoriasis and contact dermatitis based on the transcriptome was discussed. Potential morbidity described in the same study was revealed by analysis of protein expression levels. Classification of skin lesions was provided using in-depth convolutional neural arrays. The proposed display was created from the image, in a way that used the input bitmap co-credits and transmission names. The finding presents a classification of two cases: between keratinocyte carcinomas and seborrheic keratoses, and between invasive melanomas and nevi. It was proposed as a method for the detection of melanoma skin cancer. It was suggested by the creators that the deep learning process could be combined with the impregnation of the proposed skin lesions.[1] The optoacoustic dermo duplicate was demonstrated based on a task of measuring tension vitality and entrance depth for skin investigation using ultra-dermo-imaging.[3]

2. 3 Comparative studies

Five clarifications that are currently accessible regarding present-day skin infections with a look at computerized frameworks but a few are yet to be found. It is known that some

limitations and distortions have been distinguished among them as a result of which this system has tried to influence the available problems with different methods. The extended part of this investigation is to find research parcels in image preparation and data mining for image trip to understand what is very appropriate and accurate methods to use journal techniques to give a significantly superior answer to skin ailments understanding and differentiation. Where we are finds a huge balancing of portable applications for human body surface examination and cancer detection. At times, manufacturers have described their likely against several application proficient picture preparing shape smart phone camera and detecting innovations and moreover displayed lawful viewpoints of ethical, quality and straightforward improvement of apps for therapeutic utilize.[4]

2.4 Research Summary

Estimation Nevertheless, in relation to the appearance and characteristics of skin disease discovery, it provides the basis only not that which else needs to be finished who should do it to reduce risk. Of course, the key is identifying the various skin illness that are depicted by the four categories mentioned above. Regarding the body infection test, many open source platforms creates where nothing is arranged, and it mostly detects vulnerability has moved. Since the origins of specific roles in the field could be linked to specific inventions, some are among related traditional tools offer an assistance decide what uncommon and required security measurements are required to alter the chance.[5]

2.5 Scope of the problem

An essential component of our endeavors is to create a framework that can rapidly recognize between harmed takes off or sound conditions. We found through ours inquire about how well convolutional neural systems picture classification perform exceptionally well than the other calculation or strategy. The great news is that, it all can be unraveled by utilizing a smartphone. I'll make my source open for available to everybody and attempt to make it straightforward for all.

2.6 Challenges

We have combined data from many health areas. I have collected around 900 image data from kaggle. In this study, I basically created artwork for few different diseases. They are Cellulitis, impetigo, athlete's foot, nail fungus, ringworm, larva migrans. Therefore, we are trying to solve this problem by efficiently identifying the appropriate disease according to the technological method. To complete the task our initial solid platform moved to dataset collection. It became impossible to complete the project without working with a significant amount of data. As all our statistics are raw data, we have collected image from the internet Then, our PC got set up incorrectly. For photo education, we have to face many challenges. Finishing the assignment may be more suitable for us if our laptop has extra configuration.[6]

CHAPTER 3

RESEARCH METHODOLOGY

3.1 Introduction

We use a deep convolutional neural network to integrate our self-assembled dataset. This serves as the main framework for our study. We tested the output accuracy of our current version with a few other models. BA- cellulitis, BA-impetigo, FU-athlete-foot, FU-nail-fungus, FU-ringworm, PA-cutaneous-larva-migran, VI-chickenpox, VI-shingles. Few patients (2.7%) had more than one chickenpox. Concurring to WHO's information publication of 2017, passing come to 3093 or 0.39% of in general passing, positioning Bangladesh is located 63 position of the world. To counter the last mentioned, AI employ and use in this venture with ML relapse calculations, modified and build using Python.

3.2 Research Subject and Instrumentation

In this context, we use a deep convolutional neural network to integrate our self-assembled dataset. The next section can be used to define the overall form and functionality of these models. To train the most important CNN model, we used 900 images. In our switch learning model (Sequential, Xception) few images are employed for validation capability, while 900 images are used for learning features. Few photos reduced and tested.

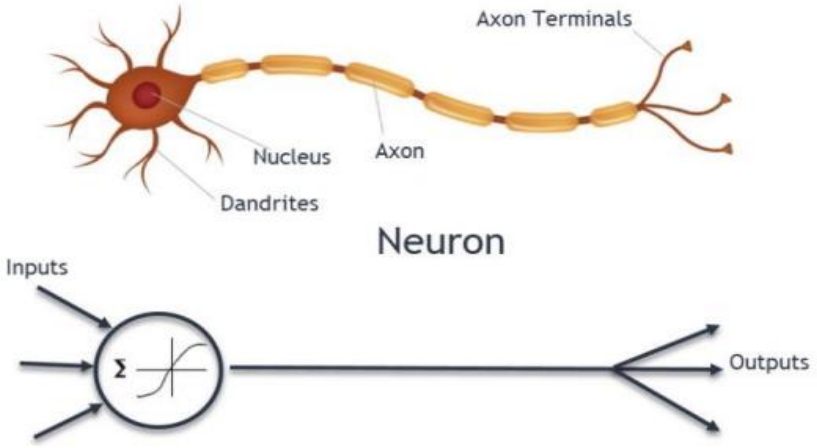


Figure 3.1: Simulated neuron Structure.

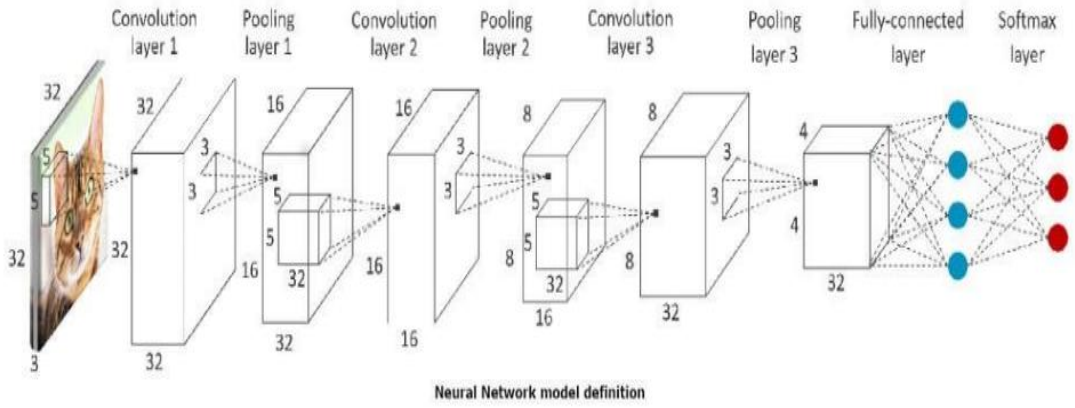


Figure 3.2: A structure of neural network model with fully connected layer.

3.3 Data Collection Procedure

In explore, I collect all the data different disease field. I collect visible picture from kaggle. This information primarily chosen since those are the crude information and for my venture, I require labeled information. I utilized 900 essential pictures as preparing information and few pictures as approval data. An over 900 pictures are collected basically eight distinctive maladies that are BA- cellulitis, BA-impetigo, FU-athlete-foot, FU-nail-fungus, FU-ringworm, PA-cutaneous-larva-migran, VI-chickenpox and VI-shingles.

3.4 Implementation Requirements

Python 3. 8

Python 3. This is the adaptation piece that results from using Python 8. It is actually regarded as a high levels programming language. The professionals employed in it use it when undertaking investigations. It is considered as one of the most excellent programming dialects for AI based applications and is very much in used in present generation software. Engineers as it is very easy to learn and fully comprehend.

Google Collab

Google Collab is free to use open source for every Python programming language. We can do it here in our browser like we used to do in Jupyter Notepad, but there is basic superiority

of this Google Collab: it provides us free online Virtual GPU and Smash. The free computer program available for Windows christened.

Hardware/Software Requirements

- ➢ Operating System (Windows 7 and the subsequent versions).
- ➢ Web browser; Preferably, Google Chrome
- ➢ Hard Disk (Minimum 4 GB)
- ➢ RAM (greater than 4 GB)

3.5 Retraining image classifier

TensorFlow is an open source umbrella for handling all aspects of machine learning. It contains a broad, adaptable container of devices, libraries, and various other community resources that advance analysts' state of the art of ML and convey to architect aural event construct introduced and ML empowered applications. Existing image verification models have thousands of parameters. Organizing them without any arrangement means a significant level of named plan data and a tremendous deal of numerical control (numerous GPU-hours or more). Move learning is a system that basic courses exceptionally take a bit of what has been decently organized in a related assignment and reuses it in another display. Working on these instructions, we will re-apply the feature extraction capabilities of previously trained abnormal image classifiers in ImageNet and prepare another organized layer in Beat. Contemporary image confirmation models have tens and now and then millions of parameters. Preparing them from scratch involves an allocation of labeled planning data and an allocation of computing control (hundreds of GPU hours or more). Trade learning is a technique that takes much of this time to take a piece of a scene that is currently arranged for a related task and repurpose it into a modern image. To implement these directions, we will reuse the extraction capabilities included from the efficient image classifiers arranged in ImageNet and essentially prepare an unused classification layer optimally. While it's not as great as planning the entire image, it's still surprisingly valuable for a variety of applications, working with tens of thousands of plan data if not millions of labeled images, and can be run in as little as thirty minutes on a multipurpose workstation

GPU. These guidelines will show you how to run the case script on your claim images and highlight a few options to help you plan.

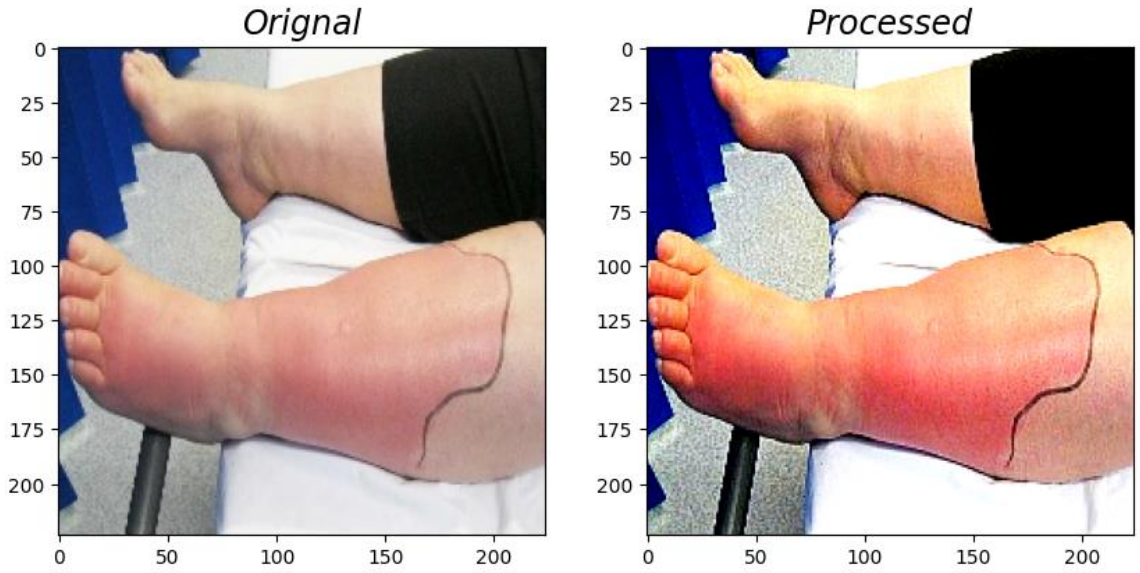


Figure 3.3: Processing of image

Figure 3.4: Categories of skin disease

CHAPTER 4

EXPERIMENTAL RESULTS AND DISCUSSION

4.1 Experimental Setup

These diseases are complex challenges facing people around the world. A single machine learning method has already been applied to detect skin diseases. Here, we correlated machine learning computations to organize skin disease classes using convolutional neural networks based on deep CNNs against the obtained results. Machine learning techniques are widely used to distinguish images. Various transmission recognition calculations have been developed to maintain very high accuracy when estimating terminal transmission. There are different types of machine learning algorithms designed to make different types of decisions about the nature of an infection at an early stage by studying specific characteristics of the disease. These counts are helpful in detecting skin infections.

4. 1. 1 Exception

That is, in effect, an extended version of IM 3: [ ] In this case, depth-aware separable convolution layers are employed as a departure from the previous one or version three.

4.1.1.1 Architecture of Xception

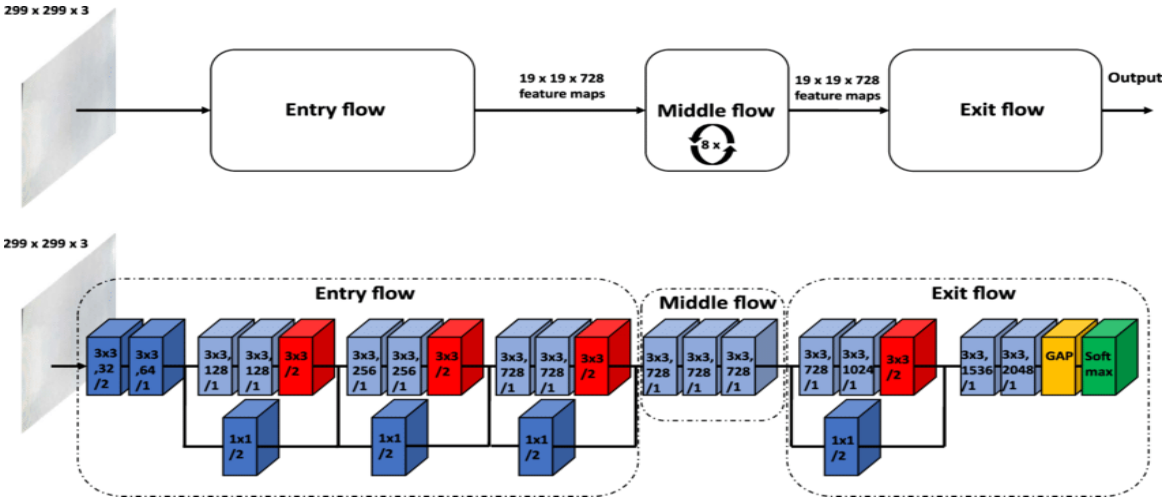


Figure 4.1.1.1: Architecture of Xception model

4.1.1.2 Segment Summary of Xception

This image shows a segment of the summary of the Xception model architecture in a neural network framework such as Keras or TensorFlow. It lists the following details for each layer:

Layer (type): The name and type of the layer.

Output Shape: The shape of the output tensor after passing through the layer.

Param #: The number of trainable parameters in the layer.

Connected to: The preceding layer(s) that feed into this layer.

The image begins with an input layer that accepts images of shape (299, 299, 3). The following layers include various types of convolutional layers (Conv2D and SeparableConv2D), batch normalization layers, and activation layers. It also features pooling layers for down-sampling. Each entry specifies the shape transformation that data undergoes as it moves through the layers, the parameters each layer holds, and the connections between the layers indicating the sequence of operations in the network.

Model: "xception"

Layer (type)	Output Shape	Param #	Connected to
input_1 (InputLayer)	[(None, 299, 299, 3)]	0	[]
block1_conv1 (Conv2D)	(None, 149, 149, 32)	864	['input_1[0][0]']
block1_conv1_bn (BatchNormalization)	(None, 149, 149, 32)	128	['block1_conv1[0][0]']
block1_conv1_act (Activation)	(None, 149, 149, 32)	0	['block1_conv1_bn[0][0]']
block1_conv2 (Conv2D)	(None, 147, 147, 64)	18432	['block1_conv1_act[0][0]']
block1_conv2_bn (BatchNormalization)	(None, 147, 147, 64)	256	['block1_conv2[0][0]']
block1_conv2_act (Activation)	(None, 147, 147, 64)	0	['block1_conv2_bn[0][0]']
block2_sepconv1 (SeparableConv2D)	(None, 147, 147, 128)	8768	['block1_conv2_act[0][0]']
block2_sepconv1_bn (BatchNormalization)	(None, 147, 147, 128)	512	['block2_sepconv1[0][0]']
block2_sepconv2_act (Activation)	(None, 147, 147, 128)	0	['block2_sepconv1_bn[0][0]']
block2_sepconv2 (SeparableConv2D)	(None, 147, 147, 128)	17536	['block2_sepconv2_act[0][0]']
block2_sepconv2_bn (BatchNormalization)	(None, 147, 147, 128)	512	['block2_sepconv2[0][0]']
conv2d (Conv2D)	(None, 74, 74, 128)	8192	['block1_conv2_act[0][0]']
block2_pool (MaxPooling2D)	(None, 74, 74, 128)	0	['block2_sepconv2_bn[0][0]']
batch_normalization (BatchNormalization)	(None, 74, 74, 128)	512	['conv2d[0][0]']

Figure 4.1.1.2: Segment Summary of Xception Model

4.1.1.3 Performance of Xception

This image displays the training progress of a neural network over 10 epochs, with each epoch consisting of 20 steps. The metrics provided for each epoch include:

Epoch number: Indicates the current epoch out of the total number of epochs (e.g., 1/10, 2/10, etc.).

Training time per epoch: The total time taken to complete the epoch, shown in seconds and milliseconds (e.g., 908s 49s/step).

Loss: The training loss value, indicating how well the model is fitting the training data.

Accuracy: The accuracy of the model on the training data.

Validation loss (val_loss): The loss on the validation set, used to monitor the model's performance on unseen data.

Validation accuracy (val_accuracy): Each epoch's metrics show progress in training and validation performance. For instance, in epoch 1, the training loss starts at 0.5709 with an accuracy of 0.8105, while the validation loss is 0.4999 with a validation accuracy of 0.9095. By epoch 10, the training loss decreases to 0.0333 with an accuracy of 0.9904, and the validation loss is 0.9994 with a validation accuracy of 0.8683. This progression indicates how the model's performance improves with each epoch, reflected in decreasing loss values and increasing accuracy values for both training and validation sets.

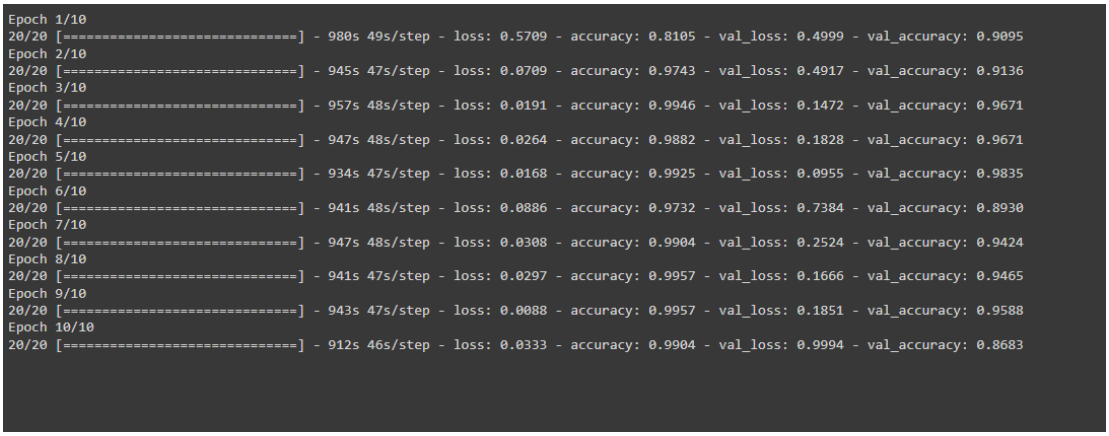


Figure 4.1.1.3: Performance of Xception Model

4.1.1.4 Visualization of Xception

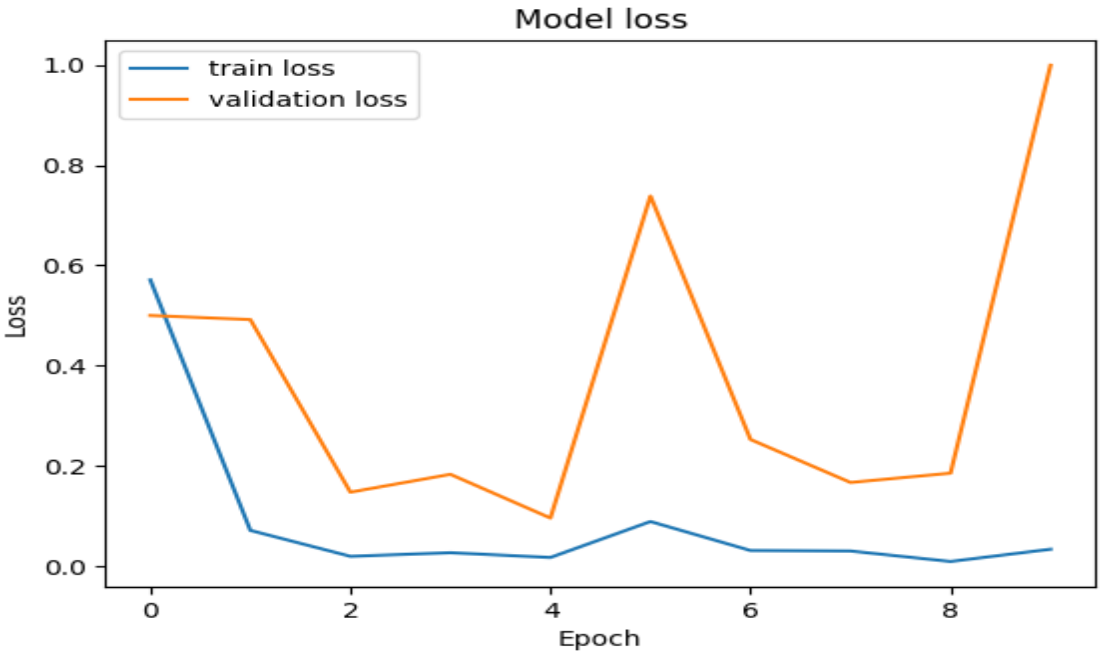


Figure 4.1.1.4: Loss of Xception Model

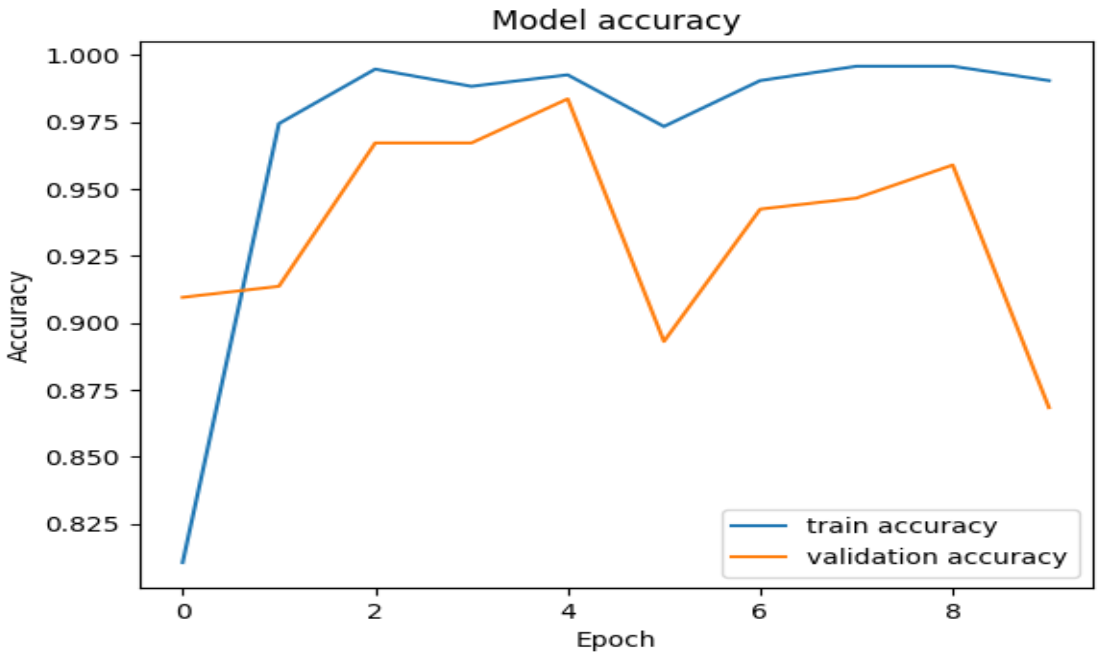


Figure 4.1.1.5: Accuracy of Xception Model

4.1.1.6 Output of Xception

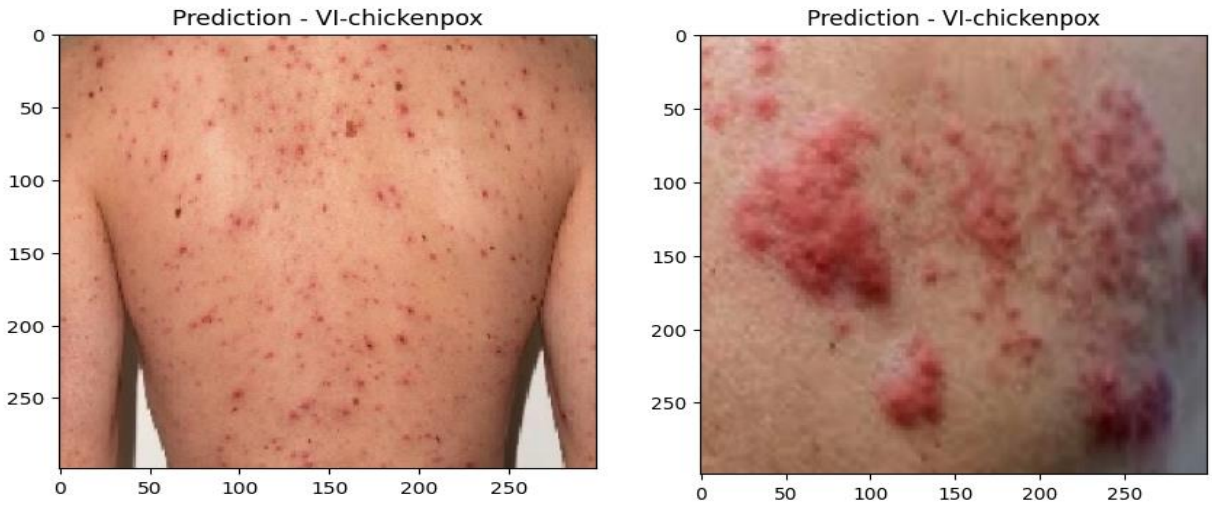


Figure 4.1.1.6: Output of Xception Model

4.1.2 Sequential Model

Sequential CNN show incorporates three connected of layers. The convolutional layer points to learn include representations of the input. Customary damp research facility testing, validations, and manufactured strategies are exorbitant and time-consuming for sedate disclosure. The proposed model encompasses five convolutional and three fully-connected layers.[7]

4.1.2.1 Architecture of Sequential

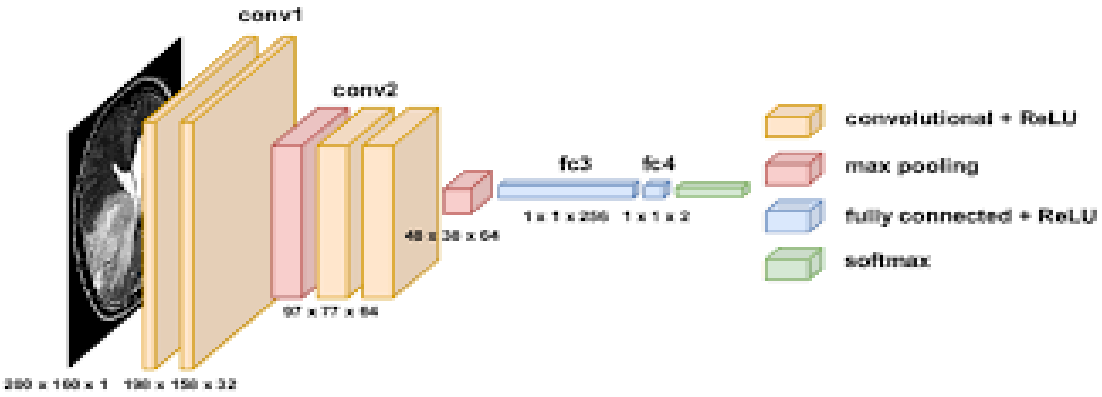
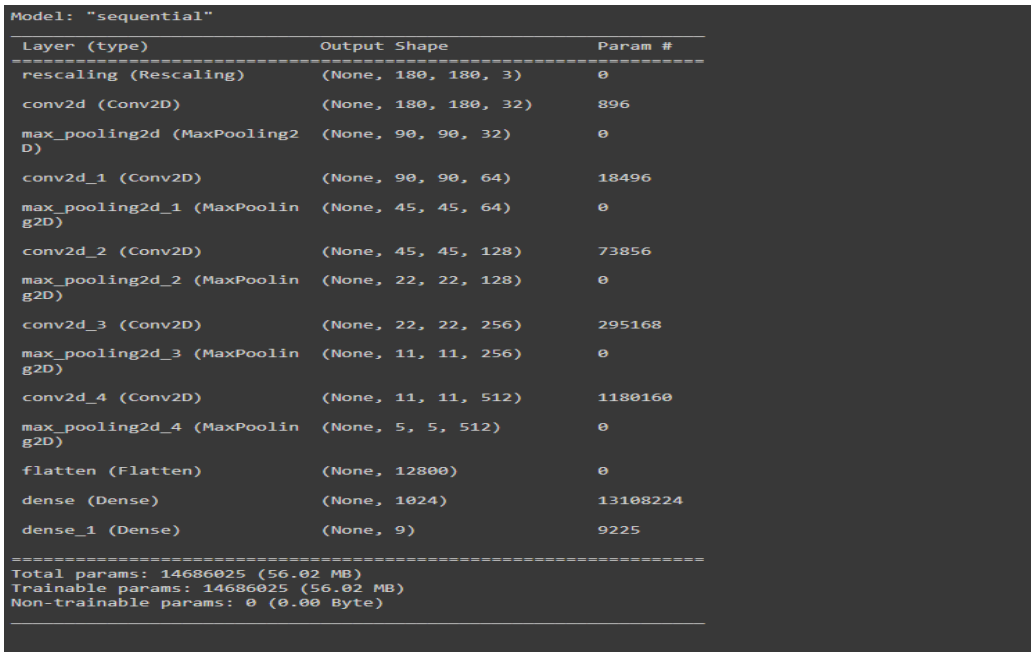


Figure 4.1.2.1: Architecture of Sequential model

4.1.2.2 Segment Summary of Sequential

- The model starts with an input layer accepting images of shape `(299, 299, 3)`.
- It then applies a convolutional layer with 32 filters, followed by batch normalization and activation layers.
- A max-pooling layer reduces the spatial dimensions.
- This is followed by a separable convolutional layer with 64 filters, again followed by batch normalization and activation layers.
- The summary also includes the number of parameters for each layer, showing which layers contribute most to the model's complexity.
- This structured description outlines the flow of data through a sequential model, detailing how each layer transforms the input and the associated parameters.



```
Model: "sequential"
_________________________________________________________________
 Layer (type)                Output Shape              Param #
=================================================================
 rescaling (Rescaling)       (None, 180, 180, 3)       0

 conv2d (Conv2D)             (None, 180, 180, 32)      896

 max_pooling2d (MaxPooling2  (None, 90, 90, 32)        0
 D)

 conv2d_1 (Conv2D)           (None, 90, 90, 64)        18496

 max_pooling2d_1 (MaxPoolin  (None, 45, 45, 64)        0
 g2D)

 conv2d_2 (Conv2D)           (None, 45, 45, 128)       73856

 max_pooling2d_2 (MaxPoolin  (None, 22, 22, 128)       0
 g2D)

 conv2d_3 (Conv2D)           (None, 22, 22, 256)       295168

 max_pooling2d_3 (MaxPoolin  (None, 11, 11, 256)       0
 g2D)

 conv2d_4 (Conv2D)           (None, 11, 11, 512)       1180160

 max_pooling2d_4 (MaxPoolin  (None, 5, 5, 512)         0
 g2D)

 flatten (Flatten)           (None, 12800)             0

 dense (Dense)               (None, 1024)              13108224

 dense_1 (Dense)             (None, 9)                 9225

=================================================================
Total params: 14686025 (56.02 MB)
Trainable params: 14686025 (56.02 MB)
Non-trainable params: 0 (0.00 Byte)
_________________________________________________________________
```

Figure 4.1.2.2: Segment Summary of Sequential Model

4.1.2.3 Performance of Sequential

The learning rate, frequently known as the step estimate, is a hyperparameter in machine learning that controls the degree to which as of late learned data supersedes already learned data. We too recognized our learning plot after doing tests. To decide the perfect learning rate, we utilize a successive show. The most reliable learning rate is given by this consecutive approach. Underneath of this models' and algorithm's learning rates.

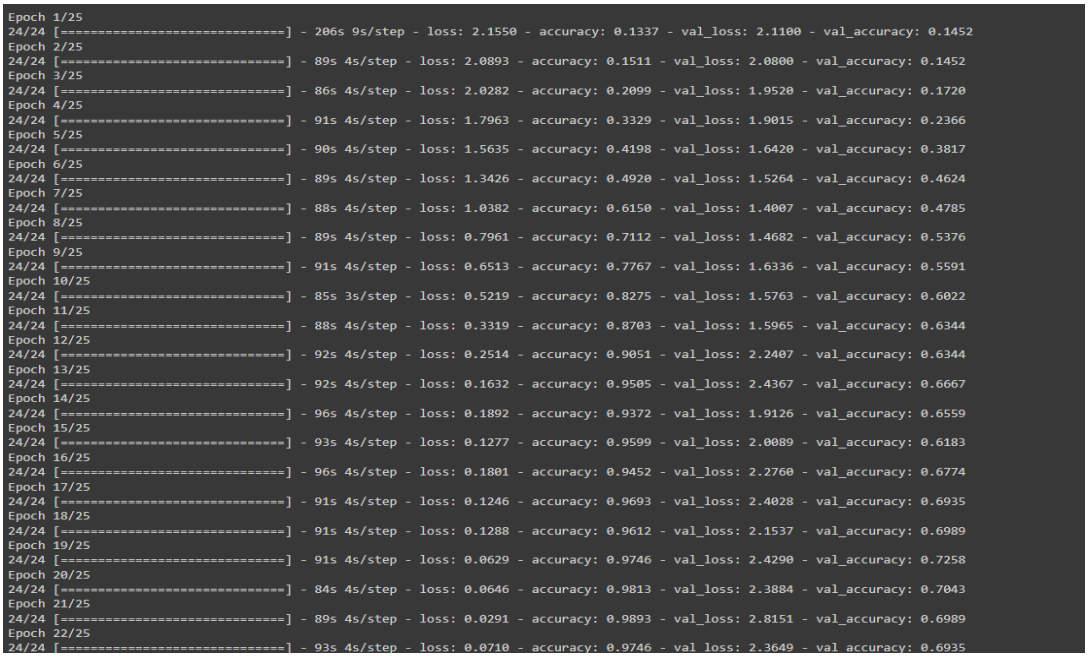


Figure 4.1.2.3: Performance of Sequential Model

4.1.2.4 Visualization of Sequential

The correct strategy utilized to prepare and assess the successive show is shown in Figure 4.1.2.4 While the green line appears preparing precision, the ruddy line appears approval exactness. The exactness of the preparing and approval stages dynamically rises for this demonstrate. Preparing and approval continue without any issues. Additionally, the two lines once in a while change from one another. This occasion appears how rapidly our dataset learns unused data.

The correct strategy utilized to prepare and assess the Successive show is shown in Figure. The exactness of the preparing and approval stages dynamically rises for this demonstrate. Preparing and approval continue without any issues. Additionally, the two lines once in a while change from one another. This occasion appears how rapidly our dataset learns unused data. Our Consecutive show approval exactness is at 89 percent.

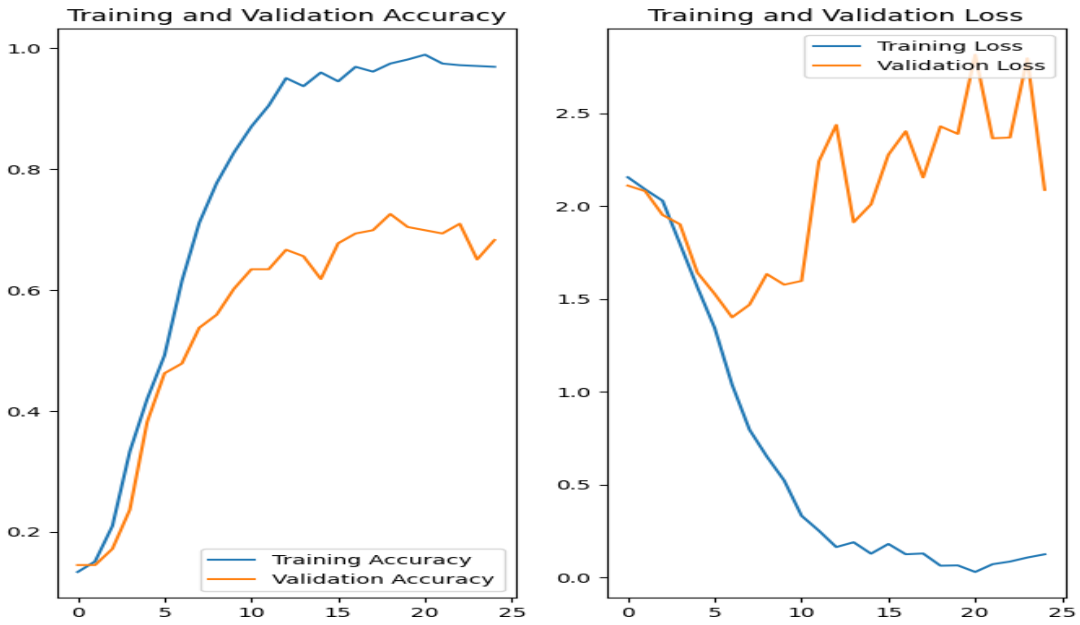


Figure 4.1.2.4: Accuracy and Loss in Sequential Model

4.2 Experimental Result and Analysis

Table 4.2.1 Functionality and Size of Mentoring Skills, Model Length, and Variant Mentoring Timeframes are explained in detail in Section 4.2.2

Model Name	Total Shape	Compliant Shape	Size (MB)	Compliant Period (Hour)
Xception	20877872	11646704	44.43	5
Sequential	14686025	14686025	56.02	Less 1

Table 4.2.1: Details Table of Applied Model

Model Name	Total Accuracy	Total Loss	Validation Total Accuracy	Validation Total Loss
Xception	92.40%	0.1244	68.28	2.08
Sequential	89.75%	0.0333	86.83	7.65

Table 4.2.2: Comparison Table of Applied Model

4.3 Discussion

Overall, using the obtained accuracy scores it is possible to conclude that the performance of the three selected models is rather high: the minimum score reaches 98% and the

maximum - 99%. It can be noted that the accuracy of the Last Xception model was 92%. 40% means it identifies the target class with near perfect accuracy of 98 out of 100. This score is generally considered good and can probably be used for a number of purposes. The sequential model again outperformed the VGG16 model with an accuracy score of 89. 75%. This indicates that the proposed Xception architecture has better performance in target class detection regardless of the challenging case. This model can be used for specific tasks including image analysis in medical applications or object detection in a self-driving car. It is equally important to note that the Xception model has an additional advantage over the other two in terms of computational time resources. Wrapping up all the above results, it is clear that all the three models got impressive accuracy scores, but the model with the highest score was found to be the hierarchical model. The appropriate model should be selected based on the characteristics of the problem to be solved, considering its size, desired level of accuracy, and other aspects.

CHAPTER 5

IMPACT ON SOCIETY, ENVIRONMENT AND SUSTAINABLILITY

5.1 Impact on Society

This consider emphasizes the psychosocial affect skin clutters on patients' quality of life and gives well-supported logical information to wellbeing specialists. This consider too found affiliations between skin illnesses and the mental and social well-being of those influenced, coming about in a negative affect their quality of life. Skin maladies can influence different ranges of a person's life, driving to expanded misery, social separation, and a decreased quality of life. These discoveries highlight the require to move forward quiet care, upgrade their quality of life, and give suitable mediations. To accomplish this, a more comprehensive approach is vital to minimize the burden of skin illness.

5.2 Impact on Environment

Skin is the biggest organ in the body and one of its primary capacities is to secure the body from harmful substances, whether they are bright radiation, harmful chemicals or prolonged/repeated introduction to water. It is the level of presentation that decides if harm to the living being will result. The hurt that can happen to the skin with adequate presentation will be considered. Contact dermatitis, halogen skin breaks out, chemical depigmentation, connective tissue maladies and skin cancer are the conditions that will be secured in this chapter, as natural introduction is critical in their aetiologies. Systemic assimilation will not be managed with. Most natural introduction to destructive substances will happen at work, but introduction may happen at domestic or amid ordinary day-to-day exercises.

5.3 Ethical Aspect

We will not charge anything for our patient after finalizing the last android app. They will constantly resort to this service for nothing. Each individual criterion is, and is intended to request certain items completely fee-free. Nowadays, most of the patient are not able to take treatment from doctor for their busy life. They spend most of the time to take care their daily life. This app gives then an advantage to known about disease and take care their skin at the same time.

5.4 Sustainability Plan

In essence, for this research I focused only eight diseases. Those are most common diseases in the world. Those diseases are creating skin disease and accrue negative impact on helth. In future I want to build a web app with user friendly interface. For this time create an application and connect the server is expensive. Also, in real world need to regular update and resolve issue and improvement I need to a team, to give best service our patients.

Strength

- ➢ Easy to utilize for all.
- ➢ Only capture pictures and distinguish the illness no highlights for live detect.
- ➢ Accurately identify the sound influenced skin.
- ➢ Cover major infection of infect skin.

Weakness

- ➢ A savvy gadget is mandatory.
- ➢ Very troublesome for uneducated people.
- ➢ This sort of app is not neighborly to our patients.

Opportunities

- ➢ skin infections can be effectively detected.
- ➢ It will contribute to the economy by assembly the needs of the country.

Treat

- ➢ For various people, smartphones are an exorbitant purchase.
- ➢ If the comes about are not precisely captured, the result may vary.
- ➢ Since numerous people in the world need formal instruction, utilizing this strategy may require costly training.

CHAPTER 6

SUMMARY, CONCLUSION, RECOMMENDATION AND IMPLICATION FOR FUTURE RESEARCH

6.1 Summary of The Study

To determine the skin disease for this research note, I used a process that study a set of rules. At a few different stages, the research process is as follow these steps:

I. First step

- Information collection
- Preprocessing image data

II. Second step

- Analysis the statics
- Gathering the knowledge about Deep Neural Network.

III. Third step

- Locking awesome version
- Discover the best version

IV. At the last and last stage

- Execute all the model
- Take the best result among them

6.2 Conclusion

As the result, people will be interested in protect skin, and they will get an incredible health. We have used transfer readings with success in several models. That's just one model. We collected as many records as possible, but it was insufficient. Our supervisor guided us through every step of the device learning principles and helped us grasp them. Since not much, if any, work on such projects has been done in Bangladesh, we hope to continue working on this research with a significant amount of data in the future.

6.3 Implementation for further study

We have already suggested some guys in the department who can do this job as we want this employment to be a total success. However, the continuation of the thorough examination is not intended. Through the API we can stitch together previous trends to us

application of Android earlier. While that was happening, our device-learning machines become the primary focus and we were not paying focus to areas like Android or server development or API construction. Another step of the further investigation will be the construction of the APIs and server. the very first step on our way to adding this model to the software. will be even this is our only reason for implementing this model.

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DEEP LEARNING-BASED SKIN DISEASE DETECTION

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