Section A-Research paper
ISSN 2063-5346

A Deep Transfer Learning-Based Approach to Detect Skin Disease

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Abstract*— Human body can have many types of disease. Some of those is internal & some of those is external. Here, we talk about external disease. Which is generally attacks the skin. Then it is called skin disease. According to who the skin disease rate in Bangladesh reached 1131 or 16% [1]. It is usually caused by seasonal changes, pollution, dirty environment, allergy and lack of skin care. Other diseases can also be caused for this disease. Our research is about all kinds of skin diseases. First, we have collected images of various skin diseases. Then we classified it using transfer learning-based algorithm. Transfer learning is currently a very popular system that is now used in almost every automation technology in the world. Our main objective is to make people aware of their skin diseases very easily. We have used some transfer learning-based algorithm to classify the skin disease. Some algorithm showed us a very good performance. But among all we have adopt MobileNetV2 and its performance. Which is 99%. We have planned to make an android app by using our adopt model where anyone can check their skin disease & confirm about their disease classification.

Keywords—*skin, transfer-learning, classification, prediction, deep-learning.*

I. INTRODUCTION

If we want to divide the disease in the human body into two parts, then one will be internal disease and the other will be external disease. Internal disease is what we cannot see. They are inside the body. And external disease is what we see, because they are outside the body on the skin. Some of the common skin diseases are: Acne, Atopic, Shingles, Hives, sunburn, Diaper Rash etc. The first mistake we make when we have this type of disease is that we don't understand what category it actually falls under. Then the mistake we make is that we do not pay attention to the disease. What happens after that is that the disease takes a very complicated form. The main reason for this is that we do not understand what disease we actually have. Because not all of us are experienced in this matter. And we don't always have a doctor around us. That's why we ignore small things. And later on, it takes a much more complex shape. In this paper, we our target was to classify all type of skin disease. We have collected skin disease image from reputed valid website. Which is approved by health organization. At first, we have chosen 5 types of common skin disease. Then we have collected the images of these skin disease image from some reputed websites. After collecting all the images, we labeled it. Then we have made 5 classes. After that we pre-processed the dataset. Then we have trained the dataset by using some transfer learning algorithm. After using some algorithm, we have got the best accuracy. Which is 99%. MobileNetV2 have done this.

II. RELATED WORK

Authors [1] have proposed a model that able to detect the skin disease. They have four types of class in their dataset. Eczema, Melanoma, Psoriasis, Healthy skin. They resized the image of the dataset & made the same length in height as well as width. At first, they preprocessed the image then feature extracted by using CNN and the last they have performed classification by using SVM classifier.

Authors [2] have collected the dataset where seven types of screen disease exist such as Mollusca, Systemic Disease, Seborrheic Keratosis, Nevus, Bullous, Actinic Keratosis, Acne and Rosacea. They have proposed a web application where anyone can able to upload their image then detect their own skin is affected or not. They have used four deep learning algorithm CNN, RESNET152V2, INCEPTION V3, ALEXNET & got the best accuracy 99% from CNN.

Authors [3] have collected data from publicly accessible dermatology repositories. They have used 80% of dataset for training and 20% of dataset for testing. This dataset has seven types of class. They have used MobileNet algorithm & got accuracy 93.6%. After that they have built a mobile application by using deep learning model. Where user can upload their image and detect their disease.

Authors [4] proposed a method and developed a computer view detection system for segmentation and recognizing skin disease. They have predicted the class both manually and automatically. They used Support Vector Machine for detecting malignant and benign tumors and the other classes are detected by manually.

Authors [5] have applied support vector machine & CNN to classify the image. They have collected dataset from Beni-Suef University Hospital, Cairo University Hospital etc. They have total 3000 data. They got the best accuracy from Support Vector Machine.

Authors [6] They have collected data from google. After collecting the dataset, they have classified this by using machine learning algorithm. They have used OpenCV for process the dataset. For implementation they have used Keras Model of Python.

Authors [7] have collected data from google. After that they have used CNN for classification the image. Their training accuracy was 91.74 % and Value accuracy was 87.33 %. They have proposed CNN for it research model.

Authors [8] They have collected data from google. They have total 9 class of image. They used deep learning to classify the image. After using some algorithm, they have adopted MobileNet V2 for their proposed model. But they also tried CNN but got less accuracy as compare to MobileNet V2.

Authors [9] Have collected dataset from Kaggle. The dataset contains total of forty thousand images. They have used total 3 machine learning algorithm. Such as, Support Vector Machine, K-Nearest Neighbor, Ensemble Bagged Tree Algorithm. And also used deep learning algorithm. Such as, VGG16, GoogleNet, ResNet50. After that they have got their best accuracy by using Bagged Tree Ensemble of a machine learning model.

Authors [10] have used CNN to classify the image. After that they also add Keras Sequential API for adding one layer at a time. After that they have got their best accuracy by using CNN. Their accuracy is 93.28 %.

III. METHODOLOGY

In our research, we have tried so many algorithms. But for better performance we have adopt MobileNetV2 algorithm.

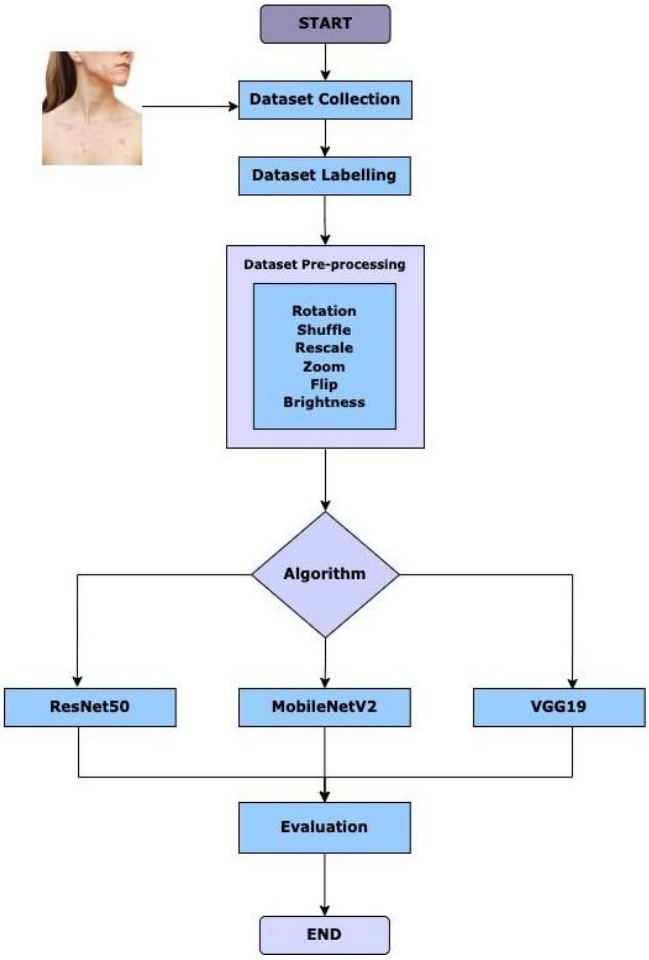

Fig.1 Methodology

Fig.1 shows us the methodology of our process. At first, we have collected data from reputed websites. Then we have labeled the data. After labeling we did some pre-process our dataset because of it was not so much clean. We have done some technique. Such as, Rotation, Shuffle, Rescale, Zoom, Flip, Brightness. Then tried some algorithms. Between some algorithm MobileNetV2 have done the best performance.

IV. DATASET DESCRIPTION

To complete our study, we gathered our dataset from some reputed. We use this data for training our model, validating and testing process. The dataset contains a total number of 772 images about various skin diseases. In our dataset there are five classes such as Acne, Hair Loss, Nail Fungus, Normal and Skin Allergy. Fig shows us the sample of five different types of skin.

Fig 2. Sample of five different states of skin

The dataset is a total of 772 images with five various classes. Acne consists of 108 images, Hair loss contains 126 images, Nail Fungus contains 172 images, Skin Allergy contains 161 images and Normal class contains 205 images. Table shows the total number of simple tests used to train the model and test.

Table 1. Dataset

Classes	Total Data	Training Sample	Testing Sample
Acne	108	82	26
Hair Loss	126	95	31
Nail Fungus	172	140	32
Skin Allergy	161	128	33
Normal	205	156	49
Total	772	601	171

V. ALGORITHM DESCRIPTION

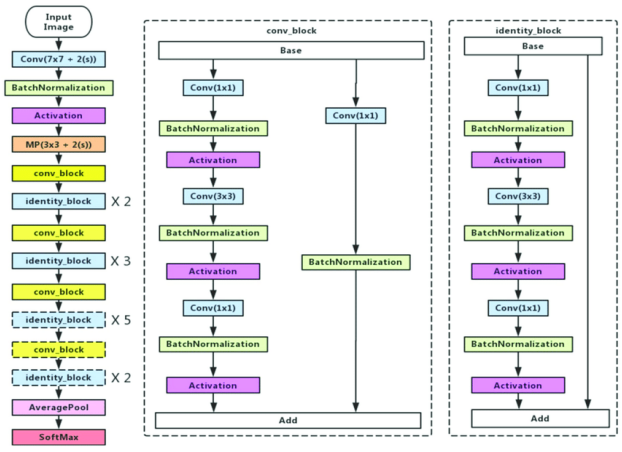

Fig.3 Architecture of ResNet50 Algorithm

In our paper, we used ResNet-50 model. It's known as a convolutional neural network (CNN) and it consists of 50 layers [12]. It is a pretrained model that was trained on over a million photos from their ImageNet database. Almost all ResNet models included double or triple layers skips with non-linearities and batch normalization. It's called ResNet50 because it can work with 50 neural network layers.

Evaluation of ResNet-50 model:

$$H_l = ReLU(b_l * f_l(H_{l-1}) + id(H_{l-1})).$$

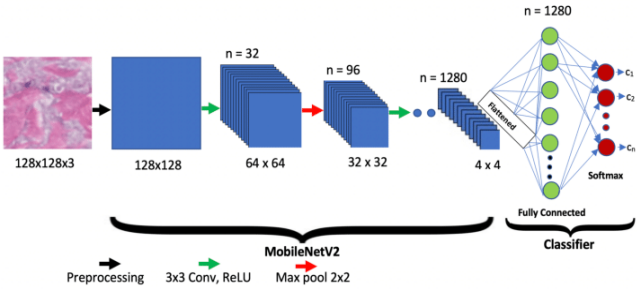

Fig.4 Architecture of MobileNetV2 Algorithm

MobileNetv2 is also a convolutional neural network, and it consists of 53 layers [11]. This algorithm aims to perform better on a mobile device. It has also pretrained network that can classify images into 1000 object classification. It is known as a powerful feature extractor that can recognize and segment objects. It is an open source model and these mobile-first computer vision models were created for TensorFlow and are optimized for accuracy.

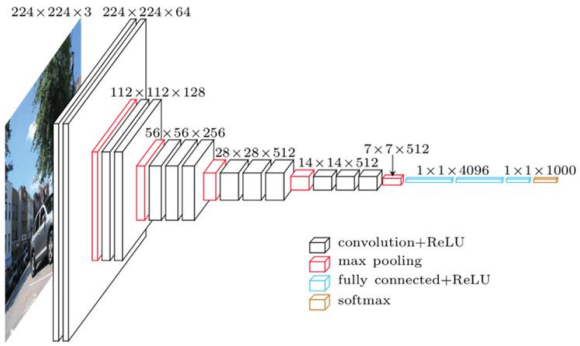

Fig.4 Architecture of VGG19

We already know that VGG19 is one of the common convolutional neural network that has 19 layers [13]. A pre - trained model variant of the network built over than a million images from the ImageNet database can be loaded. The pretrained network can categorize images into 1000 different object classes. The primary goal of the VGG network was to achieve the ILSVRC matching challenge.

VI. FEATURE EXTRACTION

In our research, the MobileNetV2 algorithm has been used to classify all kinds of features of the dataset. MobileNetV2 have two types of blocks in this algorithm. First block is residual block. Which has 1 stride. Second block have 2 strides. Which is used for downsizing. All blocks have 3 different kinds of layer. The first layer is 1 * 1 convolution with ReLU6. The second layer is depthwise convolution. And the

last layer is also 1 * 1 convolution but it has no linearity. In our implementation the ReLU6 function helps us to introduce all the hidden layers. The size of the target model was (224,224). The MobileNetV2 did some fewer losses. Which is 0.009%. But the VGG19 & the ResNet50 did more losses than MobileNetV2. Which are accordingly 0.14% & 0.03%.

Input	Operator	t	c	n	s
$224^2 \times 3$	conv2d	-	32	1	2
$112^2 \times 32$	bottleneck	1	16	1	1
$112^2 \times 16$	bottleneck	6	24	2	2
$56^2 \times 24$	bottleneck	6	32	3	2
$28^2 \times 32$	bottleneck	6	64	4	2
$14^2 \times 64$	bottleneck	6	96	3	1
$14^2 \times 96$	bottleneck	6	160	3	2
$7^2 \times 160$	bottleneck	6	320	1	1
$7^2 \times 320$	conv2d 1x1	-	1280	1	1
$7^2 \times 1280$	avgpool 7x7	-	-	1	-
$1 \times 1 \times 1280$	conv2d 1x1	-	k	-	

Fig.5 Structure of MobileNetV2

VII. Result And Discussion

In this paper, we have used 3 models to detect skin disease. In these 3 models we have got our best accuracy by using MobileNetV2 algorithm. Which is 99%. We have also tried another algorithm but got less accuracy. We have got least accuracy by using VGG19 algorithm. Which is 87%. ResNet50 also gave us good accuracy which is 97%.

Table.2 Performance

Model Name	Accuracy	Lost Function
VGG19	87%	0.14
ResNet50	97%	0.03
MobileNetV2	99%	0.009

VIII. Error Analysis

Fig.6 Training Loss & Validation Accuracy

Fig No-6 shows the training loss and accuracy estimate. The following figure tells us that, The MobileNetV2 algorithm training loss and accuracy with the graph chart. On the figure the blue line stands for training accuracy and the orange line is for training loss accuracy. On the other hand, the orange line is for train loss.

Precision:
Precision is the number of accurate class predictions that are truly positive class predictions. Basically, Precision is one evaluation of a machine learning model's efficiency and it can measure the accuracy of a positive prediction provided by the algorithm. The equation of precision is –

$$\text{Precision} = \frac{TP}{TP+FP}$$

Recall:
The recall is derived as the proportion of Positive cases that had been actually identified as Positive to that same total number of samples. Recall can find out the actual positive values.The equation of recall given below-

$$\text{Recall} = \frac{TP}{TP+FN}$$

F1 score:
The harmonic mean of accuracy and recall is used to get the F1 score. In mathematical meaning f1 score is found by the average ratio of precision and recall values. The equation that can derived the f1 score is –

$$\text{F1 score} = 2 * \frac{Precision * Recall}{Precision + Recall}$$

Table.3 Precision, Recall, F1 Score

Classes	Acne	Hairloss	Nail Fungus	Normal	Skin Allergy
Precision	0.96	1.00	1.00	1.00	1.00
Recall	1.00	1.00	1.00	1.00	0.97
F1 Score	0.98	1.00	1.00	1.00	0.98

CONCLUSION

Our research was about skin disease. We have found many interesting results in this study. Many people in Bangladesh, who do not know about this disease. They do not give importance to it. They just ignore it. As a result, it takes on huge terrifying forms. Our aim was to make every person of Bangladesh aware of this disease. That's why we started this research. At first, we have selected some common skin disease. After that we have collected the images of skin disease from internet. Then we did some pre-processing & tried to classify. We have used transfer learning-based algorithm to classify this. After tried some of algorithm we have found that MobileNetV2 performs better. Then we have adopted this algorithm. Our accuracy is 99%. Which is very amazing result. Because our dataset was very mess. After getting the result we have made a model.
In future, we will make an android app. By using our app anyone can detect their skin disease very easily & free. After detecting the disease, they will also able to know about this disease. Because we will also provide all kind of information about every skin disease in our mobile app. We think it will be very helpful for everyone.

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