International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-8 Issue-6, August 2019

Vision-Based Skin Disease Identification Using Deep Learning

R.Bhavani, V.Prakash, R.V Kumaresh, . R .Sundra Srinivasan

ABSTRACT--- Skin disease is the most common health problems worldwide.Human skin is one of the difficult areas topredict. The difficulty is due to rough areas, irregular skin tones, various factors like burns, moles. We have to identify the diseases excluding these factors.In a developing country like India, it is expensive for a large number of people to go to the dermatologist for their skin disease problem.Every year a large number of population in developing countries like India suffer due to different types of skin diseases. So the need for automatic skin disease prediction is increasing for the patients and as well as the dermatologist. In this paper, a method is proposed that uses computer vision-based techniques to detectvariouskinds of dermatological skin diseases. Inception_v3, Mobilenet, Resnetare three deep learning algorithms used for feature extraction in a medical image and machine learning algorithm namely Logistic Regression is used for training and testing the medical images.Using the combined architecture of the three convolutional neural networks considerable efficiency can be achieved.

Keywords—convolutional neural networks, Inception_v3, Mobilenet,Resnet, Logistic Regression.

I. INTRODUCTION

In this modern world, there are numerous technological advancements which are most helpful for the betterment of our lives. Various technological advancementsare being done in the medical fields. Skin diseases are the most common type of diseases. There are many types of skin diseases. Some are due to allergy while some are due to chronic diseases. Classifying the proper skin disease and treating them is a tedious one. Various diseases have various symptoms. Treating skin disease wrongly may lead to various other diseases like skin cancer. Every disease may have a pattern. So understanding the disease pattern is the only way to understand the type of disease. Usually, for a dermatologist understanding the patternsare a complex task.

Revised Manuscript Received on August 30, 2019.
* Correspondence Author
R.Bhavani*, Assistant Professor, Department of Computer Science, Sastra Deemed To Be University ,Kumakonam, Tamilnadu, India.
V.Prakash, Department of MCA, Assistant Professor, Sastra Deemed To, Be University , Thanjavur, Tamilnadu, India.
R.V Kumaresh, B.Tech CSE, Department of CSE, Sastra Deemed To Be University , Kumakonam, Tamilnadu, India.
R .Sundra Srinivasan, B.Tech CSE, Department of CSE, Sastra Deemed To Be University , Kumakonam, Tamilnadu, India.

Using the latest advanced technologies like deep learning &machine learning algorithms skin disease types can be predicted Various type of predictions and analysis are been carried out. The accuracy of the results is improvised.Using Machine Learning algorithms Support Vector Machine, Random Forest, the skin diseasesare predicted. The accuracy of the prediction is biased. The accuracy sometimes may be accurate while sometimes may not.

To overcome the accuracy issue,we carry out the transfer learning approach. Transfer Learning is nothing but gaining some basic knowledge on a problem and applying the knowledge known to the similar problem. Application of transfer learning is Deep Learning. Compared to machine learning algorithms, deep learning algorithms are far more improvised in accuracy and efficiency for skin disease prediction. These deep learning algorithms also slightly vary in accuracy. We have used three deep learning models for disease

prediction.Inception_v3[5],Resnet[6],Mobilenet[7].These deep learning models will also have accuracy errorbut very less when compared to machine learning models.So we propose an ensemble of these three neural networkmodels[8] for better prediction and accuracy. For feature extraction and classification these models are used. For training and testingdata, LogisticRegression[3] is used. This ensemble model is 80% accurate and can classify up to 15 disease classes.

Skin disease analysis and prediction using deep learning methods.

II.LITERATURE SURVEY

A. K -means

A clustering method for grouping similar data, that is popular for cluster analysis in data mining .K-means clustering[2] aims to partition observations on different categories. The problem occurs if the dataset is very large, complex and computational of clustering is difficult. So, the proposed method directly uses an ensemble of neural network models [10]where clustering is not used for better efficiency.

B. Image gradient

The edge detector[15] in most of image processing models uses an image gradient algorithm for edge detection.Using Image Gradient algorithm various points are not detected accurately.

Differentiating the background pixels and foreground pixels will not be that much accurate. For example, differentiating the skin and the background will be not accurate. This is the major disadvantage of using image gradient algorithm[3]. The proposed approach overcomes this issue. In the proposed system the features are extracted first various values differentiate the background and foreground pixels.

C. Machine Learning

Machine Learning algorithms like Random Forest[2], Support Vector Machine[2] computes the prediction techniques much effectively.But they cannot use transfer learningTheerror occursagain in differentiating pixels and also during the classification phase. The neural network is much more efficient because there are many interconnected layers inbetween The main aim of this architecture is for more accuracy and efficiency.

D. RGB color algorithm

Unique features from the medical image are taken and are segmented using Histogram algorithm. The diseases are classified based on the Histogramvalues[4] and tolerance level value of the image. We taking into consideration of mean values[4] of images RGB(RED,GREEN,BLUE).The values are calculated and the background of the images is considered to be black. This is not applicable for all images where the error in mean values may occur and the background of the image may not be black always. The proposed model does not take mean values and the features are not extracted based on the histogram. So the possibility of the wrong classification of the image is avoided.

III. NEURAL NETWORKS:

A neural network[5] consists of multiple neuron-like structures. The input image is feed to multiple neurons. The output we get is a single classified one. Various computations are taken place in the intermediate neuronsThe layers with intermediate neurons are known as Hidden Layers The weights are added for the proper output.In the neural network, the final output is known, so if the calculated output is wrong a back propagation is made and the approximate weights are updated. The activation function is used to speed up the process. In this, we use three convolutional neural network models.Convolutional neural networks are a subclass of neural networks. They are great at capturing local information and predicting based on trained data.Weuse three models namely Inception__v3, MobileNet,Resnet.The weights [5] of all the three models are taken from ImageNet website.

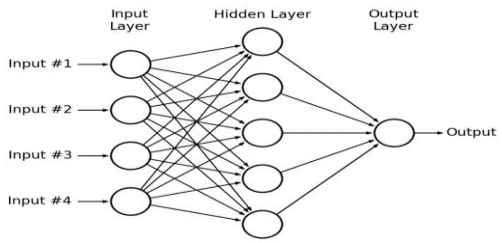

Fig 1

Fig 1: Architecture diagram of a neural network with 4 inputs and one hidden layer and one output

IV.PREDICTION TECHNIQUES

The first step in our process is identifying the techniques that are used for disease prediction and classification.The neural network model consists of two parts Feature Extraction part and classification part.These two are combinedly used to predict the diseases.

A. Inception_v3

Inception_v3 [5] revolutionary model developed by Google. It consists of two parts namely Feature Extraction and the other one is a classification part. First, for the feature classification, the input image is sent to this model. In this model the input image size (299,299,3) The images must be of type jpg. The images with larger size are made into this format. The features are classified on three major categories. They are high-level features, middle-level feature, and low-level feature. In high-level features, the entire image is considered. In middle-level features are extracted over the region. In low-level feature pixel by pixel features are extracted.

When an input image is given the features are extracted first. The model is trained with approximately 13000 images with diseases class of around 15.10% of the trained data is given as the test data for our consideration.This model is used to predict diseases with an accuracy of around 80 %. The output is provided in the form of a confusion matrix[8] with actual and predicted diseases. Based on the confusion matrix we can predict the diseases types.

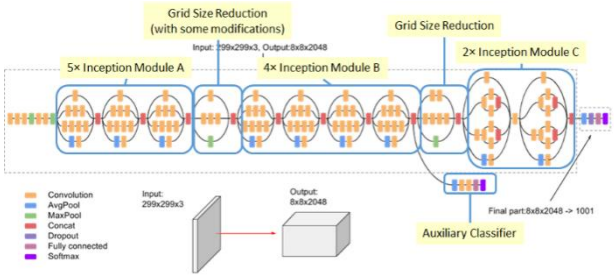

Fig 2

Fig 2:Architecture Diagram of Inception_v3.

B. Mobilenet

Mobilenet [6] is another model which is more suitable for mobile and embedded based vision-based applications

where there is a lack of computer power. This model is also proposed by Google.This model uses a depthwise separable convolution.The main usage of depthwise separable convolution [6] significantly reduces the number of parameters compared to the network with normal convolutions. This is a very lightweight application and computational time is very less when compared with Inception_v3. The input image size is (224,224,3). The number of input parameters is less when compared with the inception_v3 model. The accuracy may differ sometimes. When an input image is given the feature are extracted first. This model classifies features in three types High level,Middle level,Low level. The model is trained with a set of images approximately 13000 images with diseases classes are 15.10% of trained data is given as test data for our consideration.

After training and testing the output is in the form of a confusion matrix. From confusion matrix[8] we can predict the diseases.

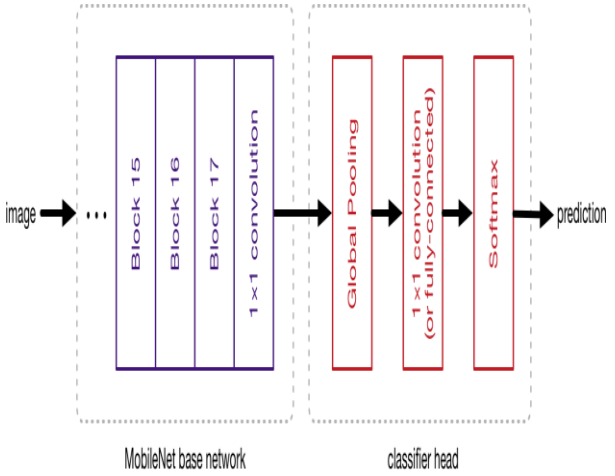

Fig 3
Fig3: Mobile Net Architecture

C. Resnet(Residual Network)

Resnet [7] isanother neural network model. It builds on certain constructs known as pyramidal which is similar in the cerebral cortex in the brain. They skip connections that is they jump overcertain layers.Typical Resnet models are implemented with a single skip.We can also have a Resnet model with multiple skips and the weights are noted on additional weight matrix. This type of typical Resnet is termed as Highway nets[7]. If the resent model has manyskips and the skips are parallel then the model is termed as Densenet[10].In this Resnet, the two types of propagation are possible both forward and backward[5]. So if the weights[5] are updated wrongly both forward and backward propagations are possible.

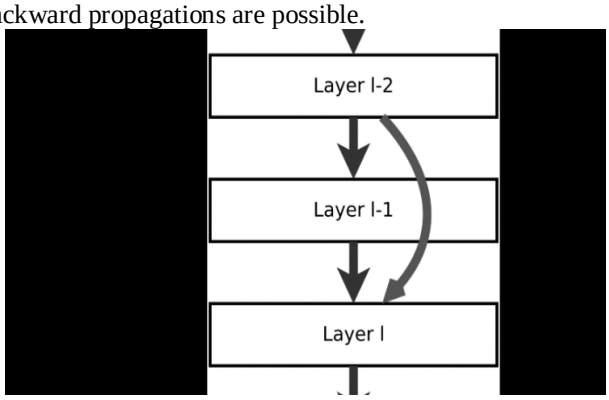

Fig 4
Fig 4: Residual network architecture

V. AN ENSEMBLE OF NEURAL NETWORKS & RESULTS

Generally, an ensemble of machine learning algorithms is used for many years. Techniques such as Adaboost[11] and Random Forest are some examples of ensembling in machine Learningalgorithms. Ensembling of neural networks has hardly taken place till now.

In the above mentioned neural network modules. Each model has its own type of architecture, their own way of input image size and own working functionalities

In this ensemble for simplification purpose, we name the neural networks as CNN1, CNN2, CNN3[8]. The final top output layer of each model is removed. So when an input is a feed tothe system three neural network models predict and classifies the diseases but the model with the highest number of accuracy is considered to be true and that prediction is shown as the end output. Hence the output is more accurate than the individual one.

A.Training And Testing

ForTraining and testing we use LogisticRegression, Logistic Regression [3] is a supervised classification algorithm [3].

In this classification problem the target variable[3] or also known as output variable can have an only discrete set of values for the input values the output variable is categorized into 3 types binomial [3], ordinal [3], multinomial [3]. On performing the logistic regression. The training is comparatively faster the traditional training techniques. From the trained data and testing data a graph is drawn for better understanding purpose.

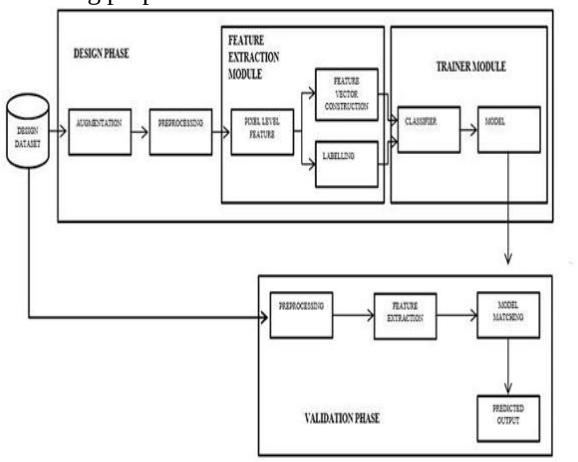

Fig 5
Fig 5: system architecture for the Ensemble of neural networks

Some examples of skin lesions that are to be identified in our Proposed model.

Fig 6 (a)

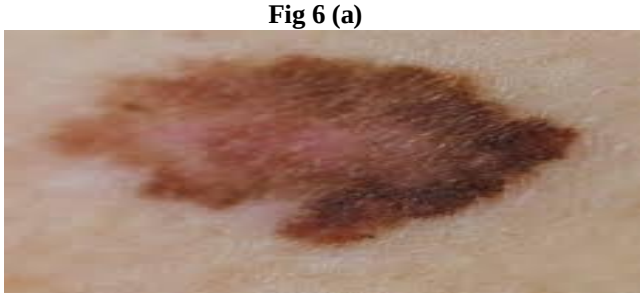

Fig 6(b)

Fig 6(a) a Skin Lesion of type acne
Fig 6(b) a Skin Lesion of type Lupus

B. Experimental Results:

Initially, 3 Disease classes are trained by all the models.
Disease 0 :Acne(42 images).
Disease 1:Actinic Keratosis Basal Cell Carcinoma(29 images).
Disease 2:Atopic Dermatitis (31 images)
Total number of images for training is 102
11% of Trained data is used as test data

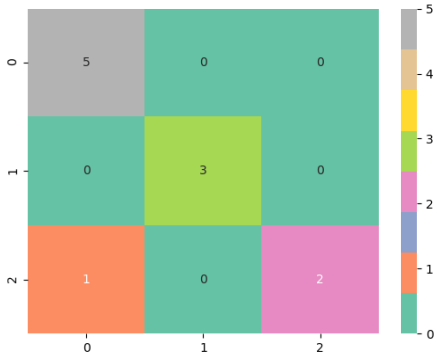

Fig 7(a)
Fig7(a): Confusion matrix output for the neural network Inception_v3

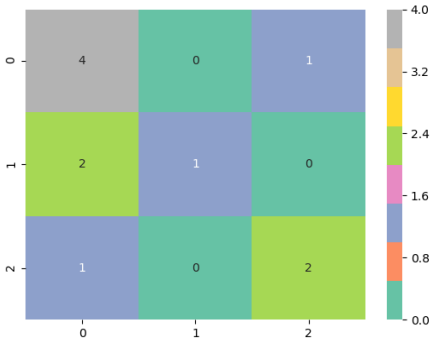

Fig 7(b)
Fig 7(b) Confusion matrix output for the Neural network MobileNet.

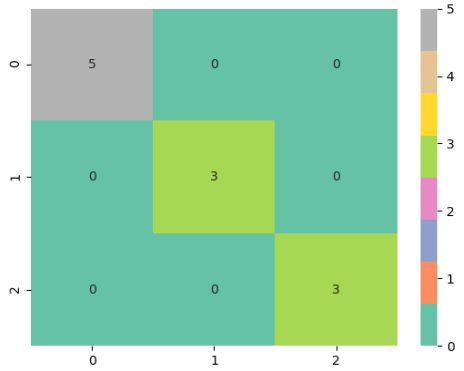

Fig 7(c)
Fig 7(c): Confusion matrix output for the Resnet.

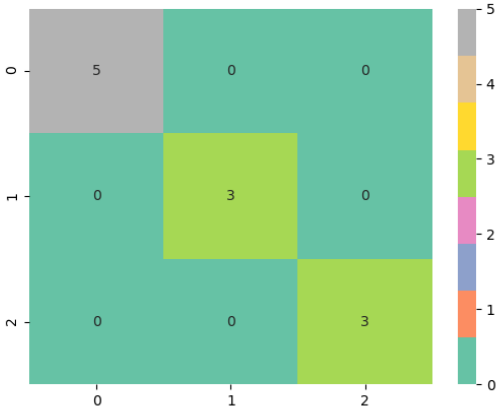

Fig 7(d)
Confusion matrix output for the final ensemble neural network

VI. CONCLUSION:

An ensemble-based approach of the neural networks is used to raise more efficiency of individual models. We propose a model in which all three neural networks come under a single architecture. The database that we use is available online. All the medical images are taken from Dermnet[8] .The combined architecture is rather more complex yet the performance evaluation shows increased efficiency and accuracy. The hardware and software requirements are rapidly increasing. One way of improving our model is to add more neural network models for improved efficiency.

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