

Skin Diseases Prediction using Deep Learning Framework



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Abstract—Dermatological diseases are found to induce a serious impact on the health of millions of people as everyone is affected by almost all types of skin disorders every year. Since the human analysis of such diseases takes some time and effort, and current methods are only used to analyse singular types of skin diseases, there is a need for a more high-level computer-aided expertise in the analysis and diagnosis of multi-type skin diseases. This paper proposes an approach to use computer-aided techniques in deep learning neural networks such as Convolutional neural networks (CNN) and Residual Neural Networks (ResNet) to predict skin diseases real-time and thus provides more accuracy than other neural networks.

Index Terms: Deep Learning, Skin disease, Convolutional Neural Network, Residual Neural Network

I. INTRODUCTION

Dermatological diseases are one of the complicated branches of science due to its complexities in the diagnosis of diseases and their variation in the changing environment. Skin diseases are the most common among them especially prone to spread and can prove to be fatal leading to skin cancer if not treated in its earlier stages [1]. The occurrence of skin cancer is now increasing in numbers than the incidence of other new types of cancer of the lung, breast combined [2]. Research induces that one-fifth of the people are likely to be affected by skin cancer in their lifetime and hence making it diagnosis more challenging [3]. Thus the computer-based diagnosis of such diseases comes into play due to its ability to produce the result within a short interval of time with more accuracy than human analysis using laboratory methods. The most prevalent technology used for the prediction of diseases is Artificial Intelligence using Deep Learning where AI can be used to develop algorithms to learn the behaviour and patterns of the disease and in turn, the machines make use of these learning methods to process the images and predict [19].

Artificial Intelligence (AI) stimulates human intelligence in machines to make them think like humans to inherit the learning and problem-solving traits that the human brains exhibit and thereby taking the best actions that allow them to achieve its goal in minimal time. It makes the machines mimic it and execute tasks, from the simplest to those that are even more complex using its goals such as learning, reasoning, and perception. Some of the previous benchmarks that used artificial intelligence are not considered to embody them since they are now made as an inherited function in computers. Machines are wired using a cross-disciplinary approach based on mathematics, computer science, linguistics, psychology, and more. The computers are thus provided with the potential to grasp even the complex theories without being specifically programmed using deep learning which humans find difficult to perceive [5]. They are used to process huge complex datasets in the healthcare industry to analyse them into medical insights [6]. Unlike machine learning, deep learning uses huge datasets and fewer classifiers resulting in more training time.

To identify a skin disease, a variety of visual clues may be used such as the individual lesion morphology, the body size distribution, colour, scaling and arrangement of lesions. By analysing the individual components separately, the complexity of the recognition process is quite increased [7, 8] and the human-engineered feature extraction method is not applicable for its classification. On the contrary, hand-crafted features are just devoted to a limited variety of skin diseases due to its diverse nature and are not suitable to be applied to classes and datasets. One way to solve this problem is to use feature learning [9] which eliminates the need for feature engineering and allows the machine to decide which feature to use by itself. Though many classification systems that use feature-learning have been developed [1, 5], most of them are restricted to dermo copy or histopathology images [23, 11]. They are mainly used for detecting mitosis, which is a cancer indicator [12]. For most of the cases, transfer learning can be utilized to train a deep Convolutional Neural Network (CNN) [13]. Also in transfer learning, instead of training the network from randomly initialized parameters, a pre-trained network can be used by fine-tuning its weights by continuing the back propagation. The reason is that the results of some of the initial layers of a well-trained network contain certain generic features like blobs, edges that are used in many tasks and such features can be applied directly to a new dataset. For the proposed skin diagnosis system, transfer learning is done by fine-tuning ImageNet [14], which is a pre-trained model along with Caffe [15], which is a framework in deep learning that is used for efficient and expressive CNN training.

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II. METHODOLOGY

Since the human analysis of skin diseases takes some time and effort, and current methods are only used to analyse singular types of skin diseases, there is a need for a more high-level computer-aided expertise in the analysis and diagnosis of multi-type skin diseases.

By using the appropriate methods the dataset is studied and then by applying various techniques and algorithms the skin disease can be predicted. Comparison among algorithms helps to achieve the best one which provides high accuracy.

Dataset: This dataset consists of 10015 dermatoscopic images categorized into 7 different classes. A complete dataset is employed to train the system model. A dataset is split into training set and validating/testing set. Validation/testing set will tune the parameters and is used only to assess the effectiveness and efficiency of the system.

Data pre-processing: Data Pre-handling is a procedure that is utilized to change over the crude information into a spotless informational collection. As it were, at whatever point the information is assembled from various sources it is gathered in crude arrangement which isn't achievable for the examination. For accomplishing better outcomes from the applied model in deep Learning ventures the organization of the information must be in a legitimate way. Some predefined Deep Learning model needs data in a predetermined configuration, for instance, Random Forest calculation doesn't bolster invalid qualities, in this manner to execute arbitrary timberland calculation invalid qualities must be overseen from the first crude informational index.

Another viewpoint is that informational collection ought to be arranged so that more than one Machine Learning and Deep Learning calculations are executed in one informational index, and best out of them is picked.

Model development: Deep Learning algorithm is the hypothesis set that is taken at the beginning before the training starts with real-world data. Linear Regression algorithm is used which uses some set of functions and chooses one that will fit the most.

Training: While training for deep learning, pass an algorithm with training data. CNN and ResNet finds patterns in the training data such that the input parameters correspond to the target. The output of the training process is a machine learning model which can be used to make predictions.

Focus on: The objective is whatever the yield of the information factors. It could be the individual classes that the information factors are mapped to if there should be an occurrence of an order issue or the yield esteem results in a relapse issue. In the event that the preparation set is considered, at that point the objective is the preparation yield esteems that will be considered.

Labels: Labels are the last yield. The yield classes is likely to be the 1names. When information researchers discuss

marked information, they mean the gatherings of tests that have been labelled to at least one name.

Overfitting: A significant thought in Deep Learning is that the estimation of the objective capacity that has been prepared utilizing preparing information, sums up to new information. Speculation works best if the sign or the example that is utilized as the preparation information has a high sign to commotion proportion.

Regularization: Regularization is the strategy to assess a favoured multifaceted nature of the Deep Learning model with the goal that the model sums up and the over-fit/under-fit issue is maintained a strategic distance from. This is finished by including a punishment the various parameters of the model along these lines diminishing the opportunity of the model.

Parameter and Hyper-Parameter: Parameters are design factors that can be believed to be inside to the model as they can be assessed from the preparation information. Hyper parameters of a model are set and tuned relying upon a mix of certain heuristics and the experience and area information on the information researcher.

III. RESIDUAL NEURAL NETWORK METHOD

Residual Neural Network (ResNet) is a design of VGG's 3x3x3. It is a design methodology that follows convolution layers. There are two layers in this block with an equal number of output channels [10]. It follows the function of activation and a layer for the process of normalization. There can be a case where the variables from a user can be added before the unit activation function omitting the above-mentioned layer operations. To add the output of those layers the output must be in the same phase as that of input. For additional operation, we can add a 1x1x1 layer for transforming the input to get the shape that we need. Images are 64 x 64 x 3 (3-channel RGB images). With a total of 2 classes, it also has a stack (15, 4, 6) with convolution layers (64,128,256,512) and these will be performed by ResNet. It has 64 filters in total before the spatial dimensions are reduced, convolution is the first layer. Finally, we have 3 sets of modules.

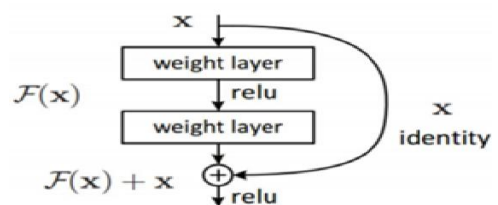


Fig.1 Single Residual Block

Each Residual module present in the convolution layer will learn the CONV filters i.e., 32, 32 and 128. After the spatial dimensions are reduced [16].

Then, stacking the residual modules of 4 sets, each of three layers with the filters 64, 64, and 256. The dimensions are reduced once again so that finally we can stack 6 sets of the residual module, the layer can learn 128, 128, and 512 filters. For the last time, we reduce the spatial dimensions, before the performance of average pooling and classifier which is softmax that applied.

IV. CONVOLUTIONAL NEURAL NETWORK

Convolutional Neural Network (CNN or ConvNet) is a deep learning algorithm used for analysing visual imagery that can accept an input image and attaches some significance to each point in the image which makes is easy to differentiate the points [17]. CNN model uses a feed forward network. The flow of information occurs in the forward direction in a feed forward neural network [18]. Convolution neural network uses MLP, which is Multilayer Perceptron, to do convolutional processes in which each neuron in a layer is associated with every other neuron in the other layers [19]. CNN techniques are well known for its better performance in image recognition. A small amount of pre-processing is needed for CNN. Several filters are used in the convolution layer; each filter makes a 2-dimensional activation map by moving across the input data [10]. One of the metrics for evaluating classification models is accuracy. Accuracy can be calculated by a fraction of predictions our system got right [20]. CNN is one of the types of neural network which is highly used in the computer science field.

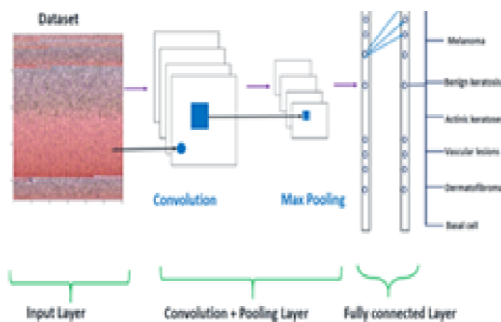


Fig.2 CNN model diagram

CNN model consists of an input layer, it is composed of artificial input neurons and output layer and also has multiple hidden layers. The hidden layers of CNN are convolutional layer, pooling layer, fully connected layer, receptive field and weights [21]. Feature extraction and classification parts are the two components of the CNN model. The feature extraction part is performed by the convolution and pooling layer [22]. The fully connected layers then act as a classifier on top of these features and assign a probability to provide final output [10].

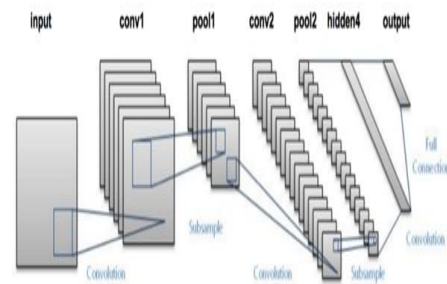


Fig.3 Basic Structure of CNN

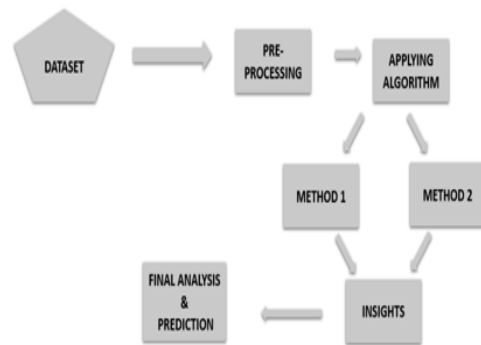


Fig.4 Proposed Framework

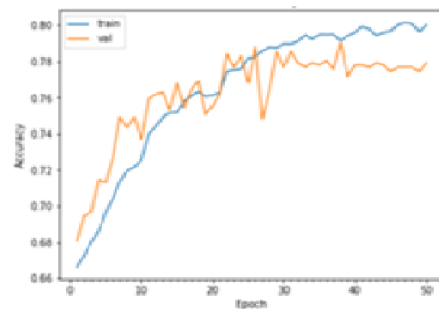


Fig.5 CNN Model Accuracy

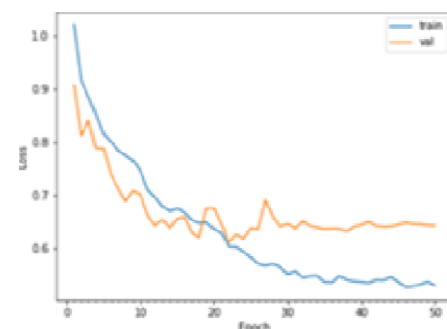


Fig.6 CNN Model Loss

V. RESULT

The better outcome achieved to predict and prevent the dermatological diseases using the techniques in Deep Learning Neural Networks (CNN) and Residual Neural Networks (ResNet) to predict skin diseases and thus provides more accuracy than other neural networks. The accuracy rate is tabulated below:



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Table 1 Experimental results

CLASSIFIERS	TEST ACCURACY
CNN	77%
ResNet	68%

VI. CONCLUSION

The feasibility of building a universal skin disease classification system has been investigated using deep CNN. Better accuracy can be obtained by providing a training set with more variance and also by increasing its size. Also, note that the images retrieved by the networks are closely related to the ground truth. We may need to design a hierarchical classification algorithm using the retrieved images to improve the accuracy. Thus by using ensemble features as well as deep learning, predictions can be achieved with a higher rate than previous models. It is also found that Convolution Neural Networks performs well compared to Residual Neural Network in the diagnosis of skin diseases.

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