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Skin Disease Predictor using Deep Learning

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Abstract – *Skin disease is a quotidian in people's life because of a significant increase in pollution and an unhygienic way of living. The repercussions of this lead to various skin diseases. Conventionally skin diseases are diagnosed visually by humans. As human's adjudication can be erroneous we tend to lean on computer-aided diagnostic system, hence in this paper, we have put forward a skin disease prediction system which is built on top of deep neural networks. The dataset is inspired by Harvard's HAM(Human against machine). Furthermore, data augmentation is been done to enhance the quality of the dataset. A sequential model has been created by using Keras. The model developed can achieve an accuracy of 82%, further improvement can be attained by enhancing the model facilitated by good infrastructure.*

Key Words: **Skin disease**, **Deep Learning, Convolutional neural network, Data augmentation**

1. INTRODUCTION

Diseases are perceived as a medical condition that is associated with a specific set of symptoms. The disease can be classified based on how much area of the body they affect i.e. Localized diseases impact peculiar parts of the body, disseminated diseases spread to different parts of the body and systemic diseases affect the whole body. Skin diseases are the disorders that affect the human skin. It has a severe impact on people's health. This has become ubiquitous and so the need for effective remedies has become necessary. Detection of skin disease is very crucial as it can cause severe loss to the people. In today's world, there is a need for an automatic diagnostic system that would help in diagnosing the disease at a faster rate and thereby reduce the manual efforts and time required to recognize the disease. Our proposed system is based on a convolution neural network which is a deep learning algorithm that helps in detecting the skin disease by taking an image of the affected area as an input to the system. The system then processes and classifies the images under specific categories. It is capable of determining 7 skin disease particularly

1.1 Deep Learning

Deep learning is a machine learning methodology that trains the machine to do what humans do, it learns from the experience. In deep learning, the model learns to perform classification of images, text-based on their respective classes. Models built are used to classify the data which can be in the form of images or text.

1.2 Convolutional Neural Network

Convolutional neural network is the subclass of neural networks that helps in image recognition, image classification, object detections, etc. Convolution neural network consists of different layers such as convolution, ReLU, pooling, and fully connected layer. Convolution layer extracts the features from an input image. It is an operation that takes two inputs that is image matrix and a filter. ReLU stands for the Rectified Linear Unit, the output of this layer is $f(x) = \max(0,x)$ where x stands for each value of the matrix. Pooling layer is used to reduce the number of parameters of the image, spatial pooling is of three types namely max pooling, average pooling, and some pooling. A fully connected layer flattens the matrix into a vector. This combines the features to create a model that classifies the image input.

2. Methodology

Our proposed system incorporates two technologies, they are deep learning algorithm i.e. convolutional neural network and web development.

2.1 Dataset

We have built our dataset using Harvard's HAM (Human against machine) dataset which is a dermatoscopic image of common pigmented skin diseases. The dataset consist of seven class i.e. it consist of seven different disease class which are actinic keratoses(akiec), basal cell carcinoma(bcc), benign keratosis lesions(bkl), dermatofibroma(df), melanoma(mel), melanocytic nevi(nv) and vascular lesion(vascu). we improvised the dataset with help of data augmentation using Keras because of the uneven and dispersed number of the images of a particular class, for instance, the class 'nv' has 6705 images out of the total 10015 images whereas class 'df' has 115 images out of 10015. This difference in the number of images led us to create the dataset to enhance the quality of the dataset which will further enrich the quality of the model's accuracy.

2.2 Data augmentation

Huge Dataset is essential for a better performance of the CNN model, so the high performance can be gained by augmenting the available data. Data augmentation helps in increasing the size of the dataset, which promotes the rise in the accuracy of the model. The operations done in data augmentation are rotation, shearing, zooming, cropping, flipping, changing the brightness level.

Rotation operation rotates the image by a specified degree, we have specified the rotation degree as 45. Shearing is used to transforming the orientation of an input image. The shear range is set to 0.3. Zooming operation is used to zoom in or zoom out. The zoom range is set to 0.2. Flipping is used to flip the orientation of the image. It is of two types, horizontal and vertical flip. Both the values are set to 'True'. Changing the brightness level helps us to combat illumination changes. The brightness range is set from 0.7 to 1.3.

2.3 Convolution Neural Network

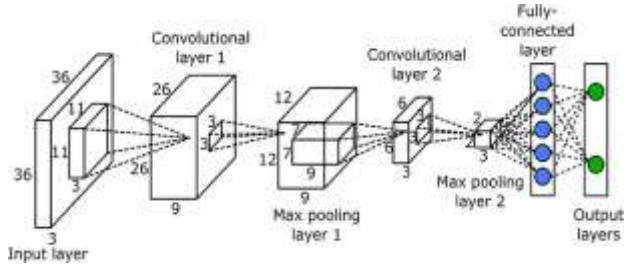

Fig -1: Convolutional neural network

Convolutional neural network is the deep learning algorithm that simulates the visual cortex of the human brain. The idea of the convolution neural network is that filters the image before training the deep neural network. It typically uses four layers i.e convolution, pooling, ReLU, and fully connected layer.

Convolution layer

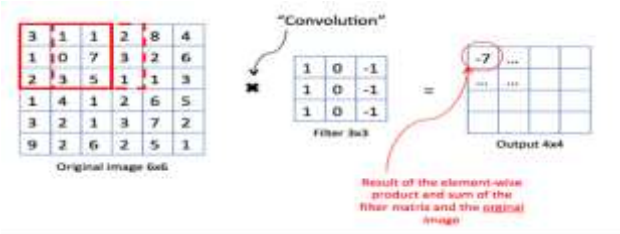

Fig -2: Convolution layer

The main purpose of the Convolution layer is to extract the features from the input image. There may be presence of more than one convolution layer in the network. The first convolution layer is responsible for acquiring the low-level features such as edges, color, sharpen, gradient orientation, etc. Further layers acquire the high-level features of the image of the dataset. It works as a mathematical operation that has an image matrix and filter as its two inputs. The image matrix is multiplied with the filter matrix, this process is called a feature map.

Strides

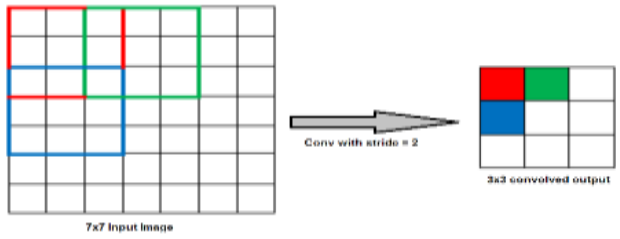

Fig -3: Strides

Strides are the number of pixels that shifts over the input matrix. When the stride is set as 1 then the filters are moved by 1 pixel at a time.

Padding

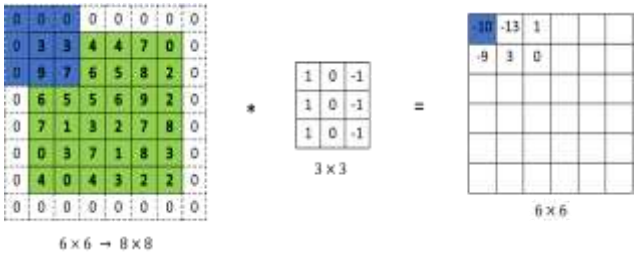

Fig -4: Padding

When the filters do not fit the image matrix then either the image is padded with zeros so that it fits, that is called zero paddings or the portion of the image where the filter does not fit is dropped, it is called as valid padding.

Rectified Linear Unit(ReLU)

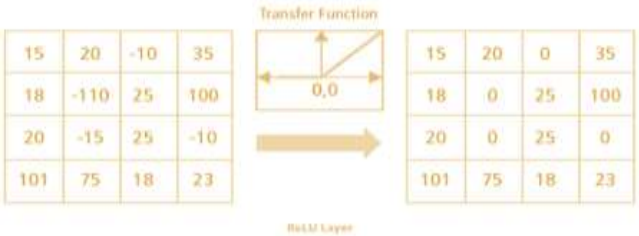

Fig -5: Rectified Linear Unit function

The rectified linear unit is an activation function which is a linear function that yields the input directly if the value is positive, otherwise, it will output zero. ReLU has become the default activation function as the model that uses it is easier to train and it also acquires better performance.

Pooling

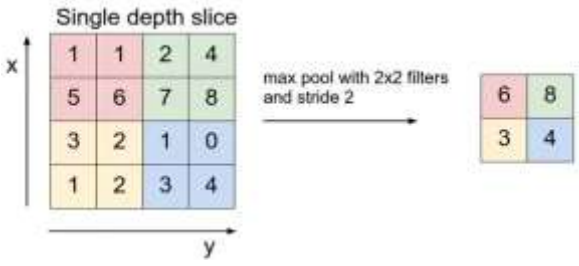

Fig -6: Pooling

The function of the pooling layer is to reduce the size of the representation to reduce the number of parameters and computation. The most common approach is max pooling.

In max pooling, for each of the area characterized by the filter, the max of that area is taken into consideration and the output matrix is created where each element is the max of the area in the Input matrix.

The fully connected input layer

The output of the convolution/pooling layer is flattened into a single vector of values that represents a probability that a particular feature belongs to a label.

As we are using Keras, there are majorly two types of models available in Keras the are the sequential model and the model class used with functional API. Here, we have used the sequential model.

Some of the keywords that we should be familiar with are optimizers, loss at which we will need to configure and compile a model. Loss: A loss function is used to optimize parameter values in a model. The available loss function in Keras are mean_quared_error, mean_absolute_error, mean_absolute_percentage_error,mean_squared_logarithmic_error, squared_hinge, hinge, categorical_hinge, logcosh, huber_loss, categorical_crossentropy, spare_categorical_crossentropy, binary_crossentropy, kullback_leibler_divergence, poisson, cosine_proximity, is_categorical_crossentropy. In the purposed model we have used categorical_crossentropy.

Optimizers: optimizers help the model in a way that it updates the weight parameter to minimize the loss fuctions. In this model, we have used 'Adam' optimizer. Apart from 'Adam', there are other few optimizers and they are SGD, RMSprop, Adagrad, Adadelta, Adamax, Nadam. The convolution neural network is trained on the augmented dataset to predict the disease as a result. This result is made available to the user

Graphical User Interface

We have developed a graphical user interface, a website, that can be used for detecting diseases by any user. It has an upload section where patient can upload the image of the affected area of the skin, that image is given to the built model as an input and the result of the CNN model will be displayed to the patient, which will be the detected disease.

3. CONCLUSION

In this paper, a model is created using a deep learning algorithm, convolutional neural network, that helps in predicting the skin disease. Data augmentation is done to improvise the accuracy of the model. The proposed model is a sequential model with top accuracy of 82%. It is found that by using deep learning algorithm, we can achieve higher accuracy and we can predict many more diseases by creating a better model which needs a good infrastructure facility. The future work is to achieve higher accuracy so that it can be as first aid.

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