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Skin Disease Classification Using Convolutional Neural Network

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Abstract - *Skin lesions are various abnormalities on the skin that appear on a patient due to many different reasons. These can be due to the exposure of skin to harmful UV rays or they can be mere birthmarks or an uncontrolled growth in the skin tissue, defined as cancer. Not all skin lesions are cancerous and therefore it is important to identify them at an early stage which can potentially improve the survival rate in case the pigment on skin turns out to be cancerous. The proposed system helps the user to identify if the spots on the skin are cancerous or benign by using their mobile devices. The model was trained on HAM10000 ("Human Against Machine with 10000 training images") dataset using convolutional neural network. The dataset comprised of seven different classes of skin lesions and augmentation was used to increase the number of images in the dataset. Due to limited number of images in the dataset, to achieve better results, the model was trained using transfer learning with MobileNet adapted for mobile use. The model was then integrated into the android application which could be used to detect whether the skin lesion is cancerous or benign using the camera of the mobile device. The proposed system can be used to detect if the spots on skin are cancerous or not by using the mobile device of the user.*

Key Words: **Skin Disease Classification, Convolutional Neural Network, Android application, HAM10000 dataset, MobileNet, TensorFlow Lite.**

1.INTRODUCTION

Skin Cancer is uncontrolled growth of cells in the body. The incidence of both melanoma and other skin cancer has been increasing over the past decades [1]. The cure rate can be reached up to 90%, where doctors can save patients' lives if the lesion is detected in the primary stage. In general, visual examination of skin cancer is difficult and can lead to misidentification of lesions, as there are similarities between the different types of skin lesions. There are different types of skin lesions like Actinic keratoses, Basal Cell Carcinoma, Benign Keratosis, Dermatofibroma, Melanocytic Nevi, Vascular lesions, Melanoma. Melanoma is considered more serious type of skin cancer than the others since it has a tendency to spread to other parts of the body and if not treated at an early stage may even lead to the death of the patient. On the other hand, melanocytic nevi are the skin lesions which are not always cancerous. They are also commonly called as birth mark or moles. It is important to classify whether the skin lesion is cancerous or benign so that the patient can undergo appropriate treatment. If skin cancers are discovered early, it could usually be cured with medicinal drugs, strategies achieved within the office by way of a dermatologist, or a simple surgical procedure. The main objective of this project is to provide an application which can be used to detect and classify the skin lesions as cancerous or benign which will help the patient to identify cancerous lesions at an early stage and seek medical treatment.

2. LITERATURE SURVEY

Skin cancer is one of the most common type of skin disorder which is chiefly diagnosed visually with scientific screening observed by dermoscopic evaluation, histopathological evaluation, and a biopsy. Diagnostic accuracy is strongly related to the professional experience of the doctor. Without additional technical support, dermatologists have an accuracy rate of 65% -80% in the diagnosis of melanoma. The model proposed in this paper uses convolutional neural networks that classifies skin lesion into benign or malignant lesion based on novel regularizer technique [2].

An approach for classification of melanoma skin cancer using Convolutional Neural Network is performed in [3]. The application makes use of Convolutional Neural Network method and LeNet-5 architecture for classification and the percentage of accuracy achieved was 93% in training and 100% in testing. The variety of education information used of 176 snap shots and 100 epochs. The application was created using Python programming language and Keras library as Tensorflow back-end.

This paper proposed the use of image processing techniques for the detection of Melanoma Skin Cancer [4]. The skin lesion image is taken as input and then by applying various image processing techniques, the proposed system checks for the various Melanoma parameters like Asymmetry, Border, Colour, Diameter,(ABCD) etc. by texture, size and shape analysis for image segmentation and feature stages and the image is then classified as normal skin or melanoma cancer lesion.

3. METHODOLOGY

The methodology of the proposed system is described in this section. The system design for the proposed model has been

divided into two parts: Building the model and Integrating the model into android application.

3.1 Dataset

The Skin Cancer MNIST: HAM10000 dataset consists of 10015 dermatoscopic images. These images were collected from two different sites, the Department of Dermatology at the Medical University of Vienna, Austria, and the skin cancer practice of Cliff Rosendahl in Queensland, Australia. The dataset includes pigmented lesions from different populations and it has images belonging to seven classes of skin lesions. Polarized and non-polarized dermatoscopy devices were used to take the images for the dataset. The dataset includes representative examples of pigmented skin lesions that are practically relevant and most of the lesions encountered during clinical practice fall into one of the seven diagnostic categories that are present in the dataset. The dataset also contains images of the same lesion taken at different magnifications or angles. The dataset also contains image of same lesion taken at different angles or magnifications. The seven classes of skin lesions included in the dataset are Actinic keratoses, Basal Cell Carcinoma, Benign Keratosis, Dermatofibroma, Melanocytic Nevi, Vascular lesions and Melanoma [5].

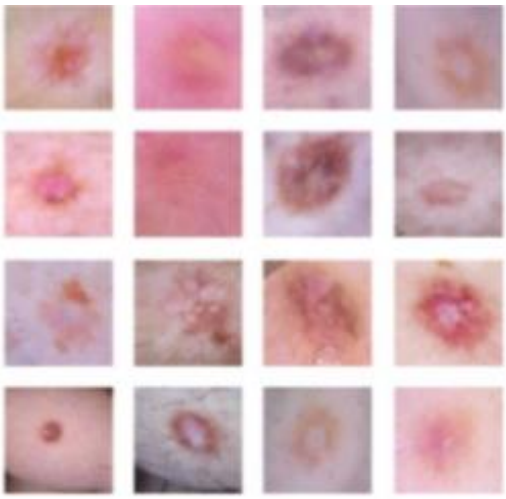

Fig. 1: Images from HAM10000 Dataset [7]

3.2 Convolutional Neural Network (CNN)

Convolutional Neural Networks (CNN) are made up of neurons having learnable weights and biases. Convolutional Networks consists of three-layer types: CONV, POOL and Fully Connected. The RELU activation function as a layer is also used which applies elementwise non-linearity. Inputs are received by each neuron which performs a dot product and optimally follows it with a non-linearity. The convolution layer is the central element of a convolutional network that performs most of the heavy computational work. Down sampling the spatial dimensions of the input is done by the pool layers. The image dataset is trained using CNN to obtain the model which can be then used to classify the skin lesions [6].

3.3 Dataset Pre-processing

Pre-processing is the technique that transforms the raw data into a format that is required by the system. The available data may contain duplicate and empty fields and also may be inconsistent. The duplicate images are removed from the dataset and the images are separated into seven folders named according to their skin lesion classes. The images are also resized and split into testing and training datasets. Using data pre-processing the dataset is made consistent for use. The training dataset will be used to train the data model to identify the skin cancer and the model will be tested using the testing data and the accuracy of the model is determined after the model has been trained.

3.4 Image Augmentation

Augmentation is the process which is used to increase the number of images in the dataset. Increased number of images in the dataset improve the performance of the system. There are different methods available such as Mirroring, Random cropping, Rotation and colour shifting for the augmentation of the images, out of which Random Cropping can be used for augmentation process. In Random Cropping the images are cropped and only that particular part is taken which system requires. For building an accurate image classifier using limited amount of data, Image Augmentation becomes a necessary step so as to improve the performance of the model by increasing the dataset is augmented using the different augmentation techniques and the number of images in each class is increased so as to have consistency in the number of images in each classes for training the model.

3.5 Building the model

The model is trained using the training dataset. Labelled images are used to train the model which is also known as supervised learning. The model is then tested using the testing data and the accuracy of the model is determined.

3.6 Creation of a mobile application for using the system

The model is converted into TensorFlow Lite format so that the model can run on mobile devices with hardware constraints. This allows the model to be integrated in the android application. The mobile application is then used through which the user takes the skin image and then the system checks whether it is cancerous or not. The type of

skin lesion is then classified and it is to the user through the mobile application.

Stepwise Procedure of Proposed Methodology

• Step 1: - Collection, pre-processing and augmentation of the dataset

• Step 2: - Splitting the dataset into testing and training images

• Step 3: - Building the model using the training dataset

• Step 4: Testing the dataset using test images

• Step 5: - Conversion of the model into TensorFlow Lite for use in android application

4. RESULTS

The confusion matrix is used to visualize performance of the model on the test data. The confusion matrix shows the number of testing images that it was able to classify accurately. Here it can be seen that the model shows a greater amount of accuracy in classifying melanocytic nevi. This shows that the model will be able to classify non-cancerous pigments more accurately.

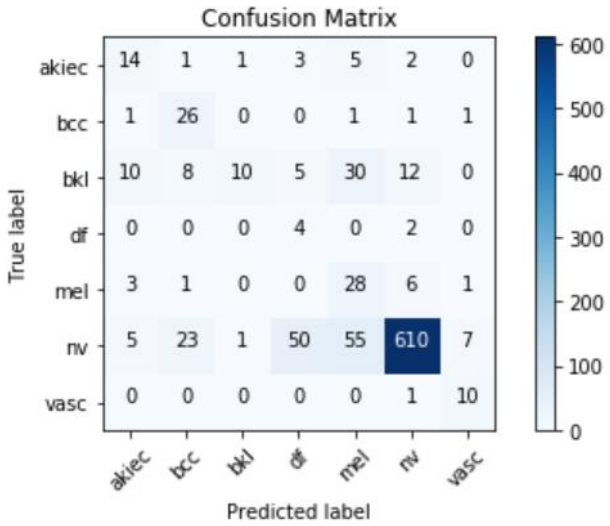

Fig. 2: Confusion Matrix

Performance measures such as Accuracy, Precision, Recall, and F1-Score are defined by means of four features such as true Positive, true Negative, false Positive, and false Negative in multiclass classification. There are three ways to calculate precision, recall, and F1-score over the whole test data: macro-averaged, micro-averaged, and weighted averaged [8].

In this proposed system, performance measures such as accuracy and weighted-average based precision, recall and F1-score are used to evaluate the performance of the classifier.

	precision	recall	f1-score	support
akiec	0.42	0.54	0.47	26
bcc	0.44	0.87	0.58	30
bkl	0.83	0.13	0.23	75
df	0.06	0.67	0.12	6
mel	0.24	0.72	0.35	39
nv	0.96	0.81	0.88	751
vasc	0.53	0.91	0.67	11
accuracy			0.75	938
macro avg	0.50	0.66	0.47	938
weighted avg	0.88	0.75	0.78	938

Fig. 3: Classification Report

The performance measure of the system can be seen in the classification report of the model tested on the test data images.

3. CONCLUSIONS

The developed model is able to classify the skin lesions using convolutional neural network. The model is trained using transfer learning to provide a better accuracy and then it is converted into a TensorFlow Lite model which optimizes the model for mobile devices so that it can be integrated in the android application. It also enables the model to perform the computations locally on the mobile device with low latency and provide the results offline. This allows the application to perform the computations locally on the mobile device and provide the result to the user on screen.

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