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A Survey on Various Methods of Skin Cancer Detection

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Abstract: *Skin lesion classification is a critical task in dermatology as accurate diagnosis of skin lesions is essential for determining appropriate treatment plans and improving patient outcomes. The ham-10000 dataset is a popular dataset of skin lesion images that has been widely used for developing machine learning algorithms for skin lesion classification. However the ham-10000 dataset is characterized by a significant class imbalance problem where the number of samples in some classes is much smaller than others this can lead to biased and inaccurate performance of machine learning algorithms particularly in identifying rare malignant lesions therefore addressing the class imbalance problem is essential for developing accurate and reliable skin lesion classification models using the ham 10000 dataset various strategies have been proposed to address the class imbalance problem including oversampling undersampling and data augmentation techniques the effectiveness of these strategies may vary depending on the specific characteristics of the dataset and the algorithm being used therefore careful consideration and evaluation of different strategies are necessary to ensure the development of robust and reliable skin lesion classification models using the ham 10000 dataset..*

Keywords: *Skin lesion*

I. INTRODUCTION

Skin cancer consists of two types: melanoma and non-melanoma cancers. Basal cell carcinoma and squamous cell carcinoma are the most commonly encountered non-melanoma tumors. According to World Cancer Research Fund International(WCRF), melanoma is the 17th most common form of cancer in the world. It is the 13th most common cancer in men and the 15th most common cancer in women. There were more than 150,000 new cases of melanoma in 2020[9].

A number of reasons make estimating skin cancer incidence particularly difficult. There are many sub-types of skin cancer which can make data collection difficult. Skin cancer detection efforts have been urged by numerous health care providers in response to the dramatic rise in melanoma incidence.

Skin cancer detection efforts have been urged by numerous health care providers in response to the dramatic rise in melanoma incidence. Despite the fact that primary care providers detect more melanomas than dermatologists, many detection opportunities are missed. In addition, primary care providers sometimes incorrectly reassure patients regarding certain lesions. According to a study, most primary care exams do not produce significant results, and many providers are ill-equipped to identify high-risk lesions adequately due to the low priority given to skin cancer in primary care[3].

The critical factor in skin cancer treatment is early diagnosis. Doctors ordinarily use the biopsy method for skin cancer detection. This procedure removes a sample from a suspected skin lesion for medical examination to determine whether it is cancerous or not. This process is painful, slow, and time-consuming. Computer-based technology provides a comfortable, less expensive, and speedy diagnosis of skin cancer symptoms.

II. LITERATURE REVIEW

In the present times, use of image processing and machine vision in the field of healthcare is increasing drastically especially in the field of cancer detection. In the year 2021, R Raja Subramanian with others, created a model for skin cancer detection using CNN with accuracy of more than 80% so to reduce the false negativity rate in the prediction to

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below 10%. Though, there are multiple researches available on the topic, but there are certain issues that needs to be addressed.

A unique methodology from artificial intelligence, known as an artificial neural network, has recently gained popularity in domains including computer vision, digital image processing, and image categorization techniques. Artificial neural networks take their cues from human brains, which include several neural layers and perceptrons. Artificial neural networks (ANNs) have been extended to include convolution neural networks (CNNs), which are delivering notable results for a variety of challenging tasks, including object detection and image processing.

A CNN is a particular type of network design for deep learning algorithms that is utilized for tasks like image recognition and pixel data processing. Due to the spark connection and weight sharing characteristics of picture pixels, convolution neural networks are favored in digital image applications over fully connected feed forward neural layers.

Three key elements make up convolutional neural networks: the convolution layer, the pooling layer, and the fully connected layer. In CNN, the Convolution layer keeps track of a number of weights that are decreased by pooling layers to produce convolution layer output and lower the layer's input size ratio. The outputs from the pooling layer are used and supplied into the fully linked layers after the convolution layer. The convolutional layer, which has a range of weights for various purposes such as image segmentation and multiple 2D matrices, is a crucial component of CNN.

III. SYSTEM ARCHITECTURE

Dataset:The HAM10000[6] data-set is being used for the creation of our model. The HAM10000 consists of 10015 skin images with 7 classes of cancer.building automated ml models for the skin cancer classification and diagnosis of skin samples is objected to by the small size and lack of diversity and effective information with the available dataset. In order to overcome this problem Harvard data verse released the HAM10000 ("Human Against Machine with 10000 training images") dataset. They collected a large number of skin samples from different areas, acquired and have been put in various senses.. The finalized dataset consists of 10015 skin images which are generally used for training deep learning algorithms and can be used in various computer vision applications.

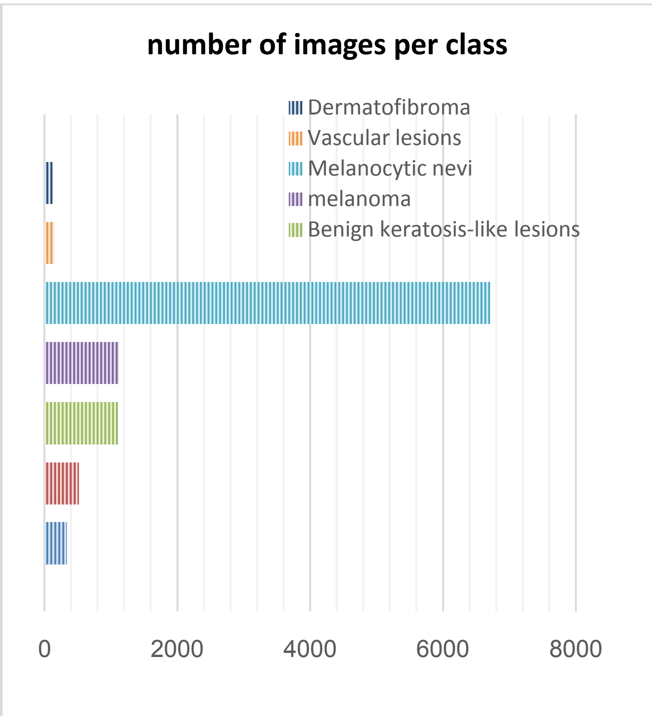

Figure 3.2: Dataset analysis - Frequency of each label in the dataset

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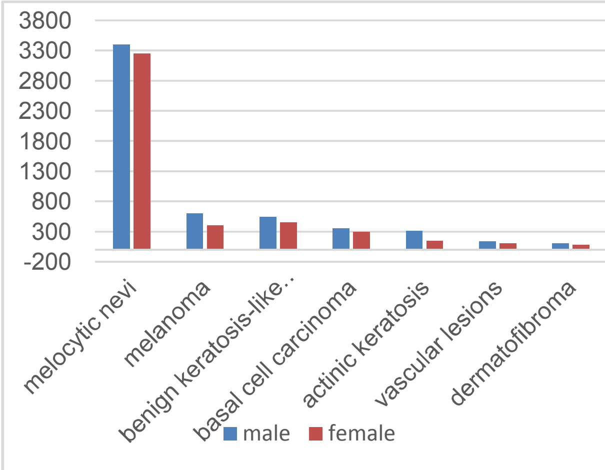

Figure 3.3: Dataset analysis - Male Vs Female frequency

Dataset includes a set collection of all important skin cancer categories in: Actinic keratoses and basal cell carcinoma (bcc) followed by , benign keratosis-like lesions like keratosis, (bkl), followed by dermatofibroma (df), followed by melanoma (mel), melanocytic nevi (nv) and lastly vascular lesions (vasc).

As we see in the above table, the dataset totally consists of 10015 images of which 6705 images belong to the same label (Melanocytic nevi). So, it's an imbalanced dataset.The plan for resolving this issue is to add more images to the dataset using scrappers and other means.

Pre-processing: The aim of pre-processing is an improvement of the image data that suppresses unwilling distortions or enhances some image features important for further processing, although geometric transformations of images (e.g. rotation, scaling, translation) are classified among pre-processing methods here since similar techniques are used[2]. Rescaling: Image scaling is used to reduce the size of the overall image. This layer rescales every value of an input by multiplying by scale and adding offset .Rotation: A rotation augmentation randomly rotates the image clockwise by a given number of degrees from 0 to 360. Width shift:It shift the image to the left or right(horizontal shifts). Randomly selected positive value will shift the image to the right side and negative value will shift the image to the left side. Height Shift:It shift the image to the top or bottom(vertical shift). Randomly selected positive value will shift the image to the top and negative value will shift the image to the bottom. Shear:Image is distorted along an axis.This is done to create or rectify the perception angles. Horizontal/vertical flip:Flips the image along the respective axis.

Activation Function: The purpose of introducing activation function is to give neural network nonlinear expression ability, so that it can better fit the results, so as to improve the accuracy. RELU: The rectified linear activation function or ReLU for short is a piecewise linear function that will output the input directly if it is positive, otherwise, it will output zero.

F(x)=max (0,x)

Pooling: Max pooling layer helps reduce the spatial size of the convolved features and also helps reduce over-fitting by providing anabstracted representation of them. It is a sample-based discretization process.

$$Dimension(pooling) = \left(\left[\frac{n_h + 2p \ - f}{s} \ + \ 1\right], \left[\frac{n_w + 2p \ - f}{s} \ + \ 1\right], n_d\right);\ s > 0$$

Convolution neural network: It is a special kind of multi-layer neural networks, designed to recognize visual patterns directly from pixel images with minimal pre-processing.We will be using this network due to the efficiency of this model with images. Also CNN doesn't produce any kind of unexplained effects which is really essential for medial diagnosis. A CNN is a particular type of network design for deep learning algorithms that is utilized for tasks like image recognition and pixel data processing. Due to the spark connection and weight sharing characteristics of picture pixels, convolution neural networks are favored in digital image applications over fully connected feed forward neural layers

IV. SYSTEM DESIGN

The CNN model used here for classification of skin cancer consists of a total of 16 layers. The images in the dataset consists of three channels R, G, B each of dimension 75x100. The image is then fed to a convolution layer with 16 filters each of kernel size 3x3 and activation function is relu (activation function is used to pass the output of the previous layer as a function to the input of the next layer).The image is passed to this layer for the first two convolutions. After the first two convolutions. A max pooling layer is introduced with pool size 2x2 and padding same passed through the image. This process is repeated with three more convolution layers and max pooling layers with different no of filters, filters and activation functions.

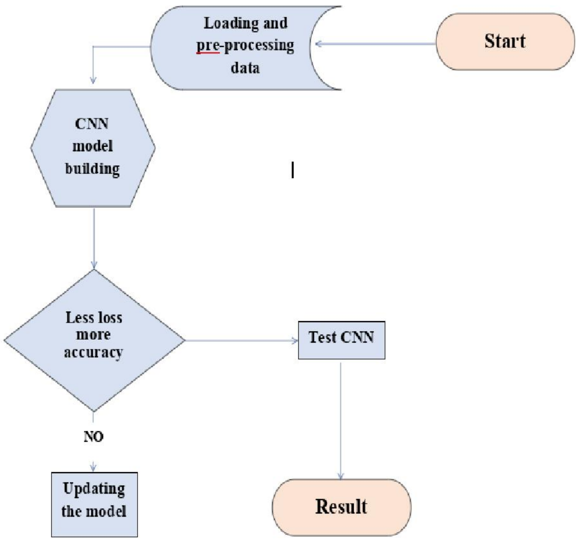

Figure 3.4: Model work flow overview

We are using django in for handling request and responses in the back-end. Django is a free and open-source, Python-based web framework that follows the model–template–views architectural pattern. The focus of the system is to get the image via the body of the form data and predicting on the image then returning the prediction with the max possibility.This kind of system makes the gaining a false positive very real and therefore more classes must be introduced to the dataset for the reduction of false positives.

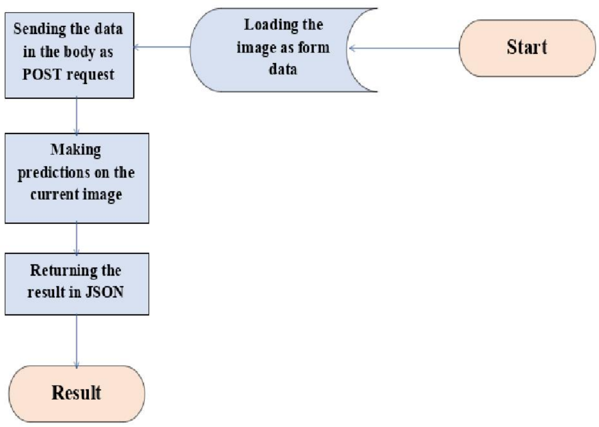

Figure 3.5: Back-end work flow overview

As shown in figure 3.5, the working of backend includes the following steps:

Loading the image as form data: This step includes storing the form data on RAM to upload on submission of the form. This can be done in all the front end frameworks. For ex:

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In HTML we can use the input type image to upload the image on submit. We can then specify the MIME type of the stored form data and upload on submit event.

```
<form method="get" enctype="multipart/form-data">
<input type="image" >
</form>
```

Sending the data in the body as POST request: The HTTP POST method sends data to the server. A POST request is typically sent via an HTML form and results in a change on the server.

For ex

A simple form using the multipart/form-data content type:

```
POST /test HTTP/1.1
Host: foo.example
Content-Type: multipart/formdata;boundary="boundary"
--boundary
Content-Disposition: form-data;name="field1" value1
--boundary
Content-Disposition: form-data; name="field2"; filename="example.txt"
value2
--boundary--
```

Making predictions on the current image: This step includes parsing the uploaded image data and then making predictions based on the existing model. We can use the predict method to make predictions on an image and it will return an array of predictions of individual classes.

V. RESULTS

The results portrays that using Leaky-ReLU instead of ReLU increases the accuracy score by a considerable margin. Also, fine tuning the hyper-parameters also plays an important role in getting the desired result. The alpha hyper-parameter of the model also needs to be configured to provide better results. Over-sampling also provides a higher accuracy score as it balances the dataset. The learning rate plays a drastic role on how the well model performs. The results also shows that deeper neural networks has a better classification accuracy even with lesser number of images.

Table 5.1: Results analysis

Model Description	Model Test accuracy	Model validation accuracy	Model test accuracy
Base VGG-16 model	0.6675	0.7100	0.6
VGG-16 model with Leaky ReLU	0.3125	0.7100	0.6
Base VGG-16 model with SMOTE over-sampling	0.1434	0.1374	0.1320
VGG-16 model with Leaky ReLU and SMOTE over-sampling	0.1634	0.1662	0.1870
VGG-16 model with Leaky ReLU which has alpha value of 0.1 and SMOTE over-sampling	0.8559	0.7692	0.8294
VGG-16 model with Leaky ReLU which has alpha value of 0.1 and SMOTE over-sampling. Also optimal learning rate of 8e-6 is used with Reduce Learning rate on a plateau.	0.9991	0.9437	0.9546

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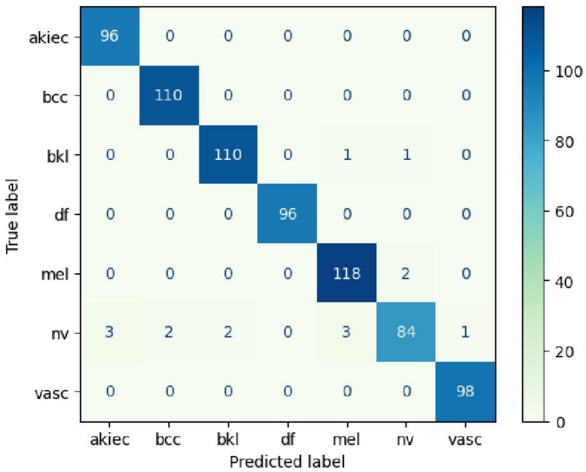

Figure 5.1: Confusion Matrix of the model

VI. ADVANTAGES & DISADVANTAGES

ADVANTAGES

- Easier diagnosis of skin cancer.
- Makes medical diagnosis more affordable.
- Decreases the skills and time taken for such skin anomalies.
- Provides a way of faster classification and treatments of such conditions.
- Provides a cheaper way for the classification of such disease as that is one of the most time consuming activities in skin cancer treatment.

DISADVANTAGES

- Requires a medical professional to operate to remove any unwanted interference.
- Requires a dermatoscope for proper imaging of the affected area which is a costly device.
- Further verification by dermatologist are required for the removal of false positives.

VII. CONCLUSION AND FUTURE SCOPE

CONCLUSION

Thus, we have implemented a system for skin cancer prediction. This system takes the input images and produces and array of probabilities for individual classes. This probability is then presented to the user who can make the decision based on the data. The end user can also access the false positive rate vs true positive rates of individual classes. The pre-existing system has an accuracy of above 80% and our system managed to produce accuracy of over 95%. Also, we have created of a fully functional system which can be easily used by a medical professional.

FUTURE SCOPE

This system can be further developed for detection of other medical conditions. There are more types of skin disorders which can also be detected with such a system. This could also include various non life-threatening disorders as well which might generally take a high cost and time to detect. It could be used by an medical professional for taking an advice and avoiding false positives

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