PREDICTION OF MELANOMA CANCER USING NEURAL NETWORKS

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***Abstract*— In recent years, skin cancer is seen as one of the most perilous form of cancers in human beings. Melanoma, a type of skin cancer, is capable of deep invasion. The most dangerous characteristic of it, is that it spreads widely over the body through the lymphatic vessels and blood vessels. Therefore, early detection and diagnosis of melanoma is an important factor for the prognosis of the disease. Recently many deep learning techniques are emerging which enable development of intelligent medical image-based diagnosis systems that can assist or help oncologists in making better decisions. This paper presents a model which will focus on skin lesion classification. Here, machine learning techniques, especially neural networks, will be used for early melanoma detection by classifying the image as malignant(cancerous) or benign(non-cancerous). The process of detection will include image processing methods like image conversion and feature extraction. The processed image will then be used to train a ML model which will be developed using Artificial Neural Networks (ANN) like Back Propagation and Feed Forward networks. The trained model can be used for classification of an image as cancerous or non-cancerous.**

Keywords*— *Melanoma, Image Processing, Artificial Neural Networks, Feed Forward, Back Propagation, Machine Learning, Dermoscopy, Skin Lesion, Classification

I. INTRODUCTION

Melanoma, one of the most lethal forms of skin cancer that is caused by abnormal reproduction of melanocyte cells. The prevalence of melanoma skin cancer is on a rise over the past few decades [1]. Estimated 76,250 new cases of invasive melanoma were diagnosed in USA in 2012, with an estimated number of 9,180 that result in death [2]. Australia has one of the highest rates of skin cancer in the world [3]. Melanoma is capable of deep invasion. The most dangerous characteristic of melanoma is that it can spread widely over the body via the lymphatic vessels and blood vessels. Thus, early diagnosis of melanoma is a key factor for the prognosis of the disease [4]. But it is often undiagnosed or misdiagnosed.

The current treatment processes involved requires biopsy of the skin, a part of the skin is extracted and diagnosed in order to detect the cancer. Diagnosis of the disease can be done using dermoscopic images but it requires physicians with very good experience. therefore, there is a need for a system in order to assist physicians or oncologists for the classification of melanoma as cancerous or non-cancerous.

This paper puts forward a computer-aided diagnostic method for skin lesion classification using Neural Networks. The basic idea is to perform detection using dermoscopic images as input to the system. Initially, image processing is carried out after that the image will be given for training to the Machine learning model, in our case an Artificial Neural Network. The network will then be trained on the images that are taken from our training dataset. Once, the model has been trained, it can be used for detection of a new input image. The new image will be processed in the same manner, after that it will be given as input to the trained to classify the input image as a malignant or a benign. Dermatologists or Oncologists may use this output to take any decisions regarding further diagnosis or analysis of the cancer.

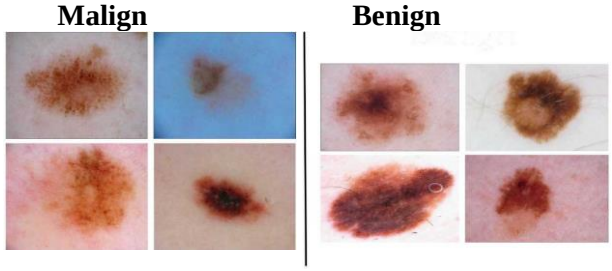

Fig.1. Sample images from the ISIC Archive dataset [12]

II. RELATED WORK

Various methods that were previously used by dermatologists involved primarily the visual inspection followed by dermoscopy, solar scan [5], epiluminescence microscopy (ELM) [6], cross-polarization epiluminescence (XLM), and side transillumination (TLM) [7] which greatly increase the morphological details that are seen thus giving additional diagnostic criteria to the dermatologist.

Several other systems and algorithms such as the ABCD lesion image analysis tool looks for various parameters like Asymmetry, Border, Color, Diameter(ABCD)etc by texture , size and shape analysis for image segmentation and feature stages. The extracted features are used to classify the image as normal skin lesion or Melanoma cancer lesion. Even, the seven-point checklist which checks for points like irregular pigmentation, change in size of lesion, irregular border, Inflammation, itching, oozing etc too has considerably less accuracy. Although these methods have enabled the enhancement of these diagnostic algorithms with good accuracy, still they showed problems that have not yet been solved. The most important drawback was that the purpose for which they were designed was not fulfilled, because the within- and between-observer concordance is very low, even for expert observers. So, there was a need of Computer Aided Diagnostic screening to classify skin lesions as malignant or benign [4].

CAD systems that made use of image retrieval approach to search for the clinically relevant and visually similar lesion gained research interest. A CAD system based on both classification and retrieval was proposed [8]. This work focused on addressing the various issues related to the development of such an integrated and interactive CAD system by performing automatic lesion segmentation with an adaptive thresholding and region growing approach, extracting invariant features from lesions and classifying and retrieving those using Extreme Learning Machines (ELM) and a similarity fusion approach.

A review of state of the art in computer aided diagnosis system and examination of recent practices in different steps of these systems was done. Statistics and results from the most important and recent implementations were analyzed [9] and reported. Comparison of the performance of recent work based on different parameters like accuracy, dataset, computational time, color space, machine learning technique etc. was summarized . Among machine learning techniques used for skin cancer diagnosis these days, SVM was prominent and the diagnostic accuracy of these systems lied in between 60%-97%. In mobile based skin cancer diagnosis system computational time was found as equal as accuracy. On average the computational time of mobile based systems is 13 – 15 sec. Work found in literature was trained and validated on different datasets which made proper comparison.

A method for accurate extraction of lesion area was proposed based on deep learning approaches. The input image underwent preprocessing and involved removal of noisy artifacts was then applied to a deep convolutional neural network (CNN). The CNN combined local and global contextual information and output was a label for each pixel, producing a segmentation mask that showed the lesion area. This mask was further refined by applying some post processing operations. The experimental results showed that this proposed method outperformed the existing state-of-the-art algorithms in terms of segmentation accuracy [10].

A deep-learning based approach was used to solve the problem of classifying a dermoscopic image containing a skin lesion as malignant or benign. The proposed solution was built around the VGGNet convolutional neural network architecture and used the transfer learning paradigm [11]. Experimental results achieved a sensitivity value of 78.66%, which was significantly higher than the current state of the art on that dataset.

III. PROPOSED METHODOLOGY

This paper presents a system for melanoma prediction using machine learning. This system will classify dermoscopic images as malignant(cancerous) or benign(non-cancerous). The dataset [12] will be divided into training image set and the test image set. Initially, the images in the training set will be given as input which may be malignant or benign. After uploading the images, they are processed which includes image conversion, segmentation and feature extraction. The machine learning model is built based on the input images by using artificial neural networks(ANN) and back propagation learning rules. new test image is given to the trained model to classify it as cancerous or non-cancerous.

In the proposed system, the images are given as input to the model which are captured using an instrument called dermoscope. The training and classification process involved is shown in Fig.2.

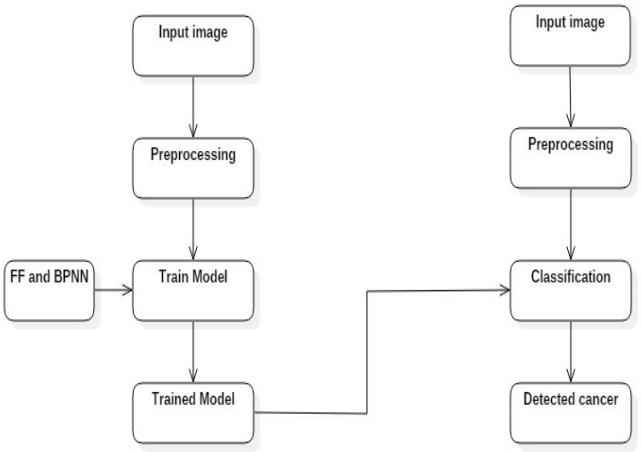

Fig.2. Architecture of Proposed Method

A. PRE- PROCESSING MODULE

The major step taken towards the classification of dermoscopic images is image preprocessing which is used to improve the quality of the image, reduce unwanted distortions and enhance image features. In diagnosis results it has been observed that dermoscopic images contain some artifacts like air bubbles, dermoscopic gel and black frames. These artifacts may create barrier while classification which results in accuracy loss. Another unwanted artifact present in dermoscopic images is hair as shown in Fig 3.

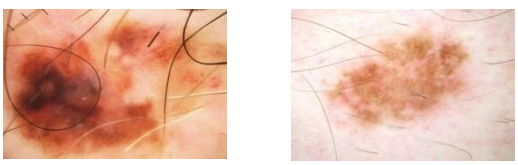

Fig.3. Hair affecting skin lesion classification

The various steps involved in image processing are as follows:

i) RGB to HSV conversion:

Color vision can be represented using RGB or HSV color model. HSV represents color information in terms of Hue, Saturation and Value. Strength of color that is light or dark is represented by value factor. Color information of images is plays an important role. Hence, the image will be converted to the HSV color model as it is preferred over the RGB model because it separates the image luminance from color information.

ii) Segmentation:

The image will then be divided into blocks of predefined size. The purpose of segmentation is to differentiate the skin lesion from healthy skin. By using segmentation the representation of image is changed so it becomes easier to evaluate. Image boundaries are defined and labels are assigned to each pixel so that same labels can share certain properties using segmentation. Main segmentation techniques are represented using Fig 4.

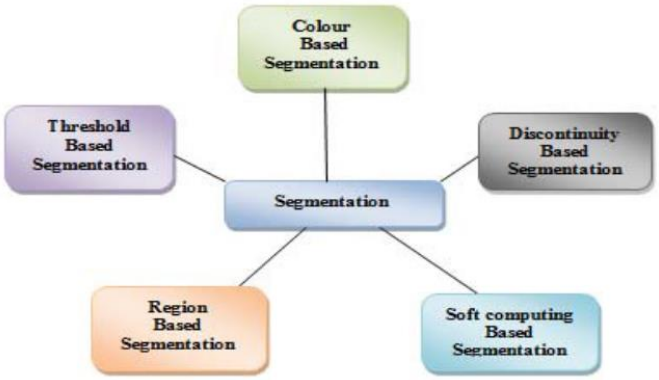

Fig.4. Various segmentation methods

iii) Feature Extraction:

Features are prominent and distinct attributes or aspects of an image. Features are vital while considering the accuracy. Histogram based feature extraction shall be used based on values of hue, saturation and value(HSV).

B. TRAINING MODULE

The extracted values of features of each training image will be given as input to the neural network to each of the input layer neurons. The network will be trained using the back propagation(BP) rule as:

i) Initially the weight values are assigned randomly.

ii) Values of each of the neuron is computed using these random values and the input layer values.

iii) The output values are compared with the target to compute the value of some predefined error function.

iv) The error is fed back through the network.

v) Using this information, the network adjusts the weights of each connection in order to reduce the value of the error function.

vi) This process is continued until the connection weights in the network have been adjusted so that the network output has converged, to an acceptable level, with the desired output.

C. CLASSIFICATION MODULE

The feature values will be calculated for the new, unseen test image. These values will be provided as input to the trained model. The output will be calculated based on these feature values which will classify the image as cancerous or non-cancerous. In case of misclassification, the error will be fed back in the network so that the image can be correctly classified.

IV. DATASET

The system will use the ISIC (International Skin Imaging Collaboration) archive dataset for Skin Lesion Analysis towards melanoma detection. The dataset is having a mixed representative of malignant and benign images [12].

V. CONCLUSION

Thus, this paper puts forward a method for prediction of Melanoma Skin Cancer using Artificial Neural Networks. Use of Artificial Neural Networks for prediction is done to increase the accuracy of the systems currently being used. This system can be used to aid dermatologists or oncologists for diagnosis and analysis of skin lesions which helps them to take further important decisions.

The method used is user friendly, reduces the biopsy related cost and also provides an application as an assistant to doctors.

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