SKIN LESION DETECTION USING CONVOLUTION NEURAL NETWORK

S Tamilselvan[1], S Priyadharshini[2], K V Raksana[3], J P Sujitha shree[4]

[1]*Assistant professor, Dept. of ECE, Bannari Amman Institute of Technology, Sathyamangalam, Tamil Nadu, India*
[2-4]*UG student, Dept. of ECE, Bannari Amman Institute of Technology, Sathyamangalam, Tamil Nadu, India*

---***---

Abstract - *One of the most common type of disease with a cancerous growth in skin is skin lesion which is chiefly examined visually, beginning with a scientific screening observed by dermoscopic evaluation, histopathological evaluation, and a biopsy. Skin lesion datasets usually comes in various layout and shapes including medical photos, were the data require exquisite efforts for pre-processing. Due to the high-quality-grained variations in the skin lesions, computerized type is quite challenging through images. To accomplish especially isolated and standard perceptions against the finely grained object grouped, profound convolution neural organizations (CNNs) are utilized. This is to classify pores and skin lesions into benign or malignant based on a novel regularizer method. The first section is to put together picture dataset, and segmentation is done to find useful components that are less difficult for evaluation and to detect area of interest in digital photos, reduce the quantity of noise and picture illumination, and to easily locate sharp edges (barriers). Then, the proposed method builts a Convolutional neural network model which includes convolution layers max pooling layers, and fully linked layers. The overall performance of CNN with an embedded novel regularizer is tested on multiple use cases. The proposed study will outperformed the present algorithm with a greater accuracy.*

***Key Words*: *CNN, Skin cancer, image processing, melanoma*.**

1. INTRODUCTION

The world we are living is emerging with number of new technologies and it is getting digitalized too. This era is budding with endless inventions and getting in contact with different technologies every day. Every field and department has their own developments to deal with their own problematic questions. Especially Medical field has gone too far in its growth and its developments, ideas are in perfectly good range to fulfill patient needs. Years back, disease in heart, lungs, kidney makes a major fear in all of us. But the situation today is totally different; it is just because the technology stands as a major backbone. Nowadays humans are facing lots of diseases due to large factors. In that list, skin diseases is a major problem we face. We may undergo lots of skin disease, but one of the deadly disease is skin cancer. It can't be recognized visually because its appearance is same as allergic skin, just visual diagnosing can't give a promising result whether it is benign or a malignant disease. So the major problem here is diagnosis. To overcome it, numbers of diagnosing methods were proposed. Among that, Skin lesion detection using Convolution Neural Network stands as the solution to deal with. It is nothing but, one of the type of artificial neural network that deals with processing, recognition of image and particularly designed to process pixel data.

Convolution neural network has settled its footprints in major fields like security .CNN is composed of four layers namely convolution layer, ReLu layer, pooling layer, fully connected layer. Convolution layer is a filter, where the neuron is connected to the local area of the input neuron, it is not fully connected to the neuron because, and it filters the important features so that it grows deeply with fewer parameters. ReLu layer increases the nonlinear properties without affecting the convolution layer. Pooling layer reduces the dimensions of the image and summarizes the features available in the image that is generated by convolution layer. Fully connected layer is the added advantage to the CNN when compared to the other neural network; the major advantage is that it connects all neurons of one layer to all the neurons of other layer. It works by taking an input and selects specific parameters in an image and then it differentiate it from other parameters. The main advantage of CNN over other neural network is that it automatically detects the important features in the given input without human intervention. Skin lesion detection using convolution neural network classify the given input image and checks whether it is a benign or malignant disease. In this, we will have two phases namely testing and training phase. This system uses 70% of the images for training and the remaining 30% images from the dataset are used for testing. This process has various steps such as pre-processing, segmentation, feature extraction and classification. Initially the input image is converted into the grey scale image and fed as a input, next this process steps into pre- processing stage were as this stage is used to resize the image and used to improve the quality of the image. This process is also used for image enhancement. Segmentation is used for extracting important features from the image and it separates the extracted features from the other features embedded in the image. Feature extraction is slightly same as the process in segmentation, along with it, this reduces the number of features that is extracted (takes more specific feature from the image), so it makes even easier to handle large amount of dataset. The last stage is classification, by undergoing all these processes, it classifies whether the given input image is benign or malignant. This process uses an algorithm named Novel Regularizer. It is the technique where classifier complexity is controlled and it is used to reduce the over fitting and has high efficiency when compared to the other regularizer.

2. RELATED WORK

The literature shows several attempts to diagnose carcinoma cases using deep learning techniques, like CNN.

Esfahani et al. (2017) proposed CNN architecture for diagnosing melanoma lesions, clinical images were preprocessed so on reduce image illumination, then images fed to Convolutional neural network models[1].The CNN model was successful to differentiate between malignant and benign images. Experimental results show that the proposed method was capable to diagnose melanoma lesions cases.

Giotis et al. (2018) presented an expert supervisor call instruction MEDNODE to help doctors in melanoma detection[2].The proposed system used extracted lesion regions within the image, then computes indicators just like the color and texture, in conjunction with visual attributes provided by experts. The proposed system performed comparably to state- of-the-art methods.

Mahbod et al. (2019) shown that Convolutional neural networks is superior over traditional methods [3].They proposed a hybrid fully automatic computerized method for skin lesion classification, they used three pre-trained deep models (AlexNet, VGG16, ResNet•18) to extract features. The extracted features then are used to train SVM (support vector machine) classifiers and evaluated on the 150 validation images from the ISIC 2017 dataset, the proposed method is shown to understand excellent classification performance.

Jaisakthi, Chandrabose, and Mirunalini (2018) proposed how for skin lesion segmentation in images and to classify carcinoma types from images[4].The proposed method consists of preprocessing and segmentation using semi supervised learning algorithm. The aim of the first phase is noise removal using filtering technique, the second phase skin lesions are segmented supported clustering technique. The images were downloaded from the ISIC 2017 challenge webpage, the experimental results shown low accuracy but will draw a map for future improvement.

Barata et al., (2017) proposed two methods for detection of melanoma in dermoscopy images supported global and native features[5].the worldwide method uses segmentation and wavelets, and thus the linear filters followed by a gradient histogram are used to extract features like texture, shape and color from the entire lesion. Then a binary classifier is trained from the data.

Xie et al., (2016) proposed classifying melanocytic tumors as benign or malignant by the analysis of digital dermoscopy images [6] .it done by three steps. First lesions are extracted employing a Self Generating Neural Networks (SGNN), Second color, texture and border features are extracted, and the third lesion objects are classified employing a network ensemble classifier to achieve desired output.

Yu et al., (2020) present a hybrid classification framework for dermoscopy image assessment by combining deep convolution neural network (CNN), Fisher vector (FV) and linear Support Vector Machine (SVM) [7].Codella et al., (2017) report new state of–the art performance using Convolution Neural Networks to extract image descriptors by employing a already trained model from the Image Large Scale Visual Recognition Challenge (ILSVRC) 2012 dataset. They also investigate the foremost recent network structure called Deep Residual Network.

Thompson et al., (2019) proposed vector based pattern analysis and classification approach for dermoscopy images [8]. Lesion part in the image is segmented using region based statistical region merging (SRM) algorithm. Scale invariant based sped up Robust Features (SURF) technique is used for feature point detection and description. The pattern detected is assessed using Multi SVM classifier.

3. CONVOLUTION NEURAL NETWORK

Convolution neural network is the type of artificial neural network that deals with processing, recognition of image and particularly designed to process pixel data. It has one or more convolution layer or filter which is used for processing, classification, segmentation, feature extraction from the image. It follows a hierarchical steps to process the image and the layers embedded in this process are convolution layer, ReLu layer, pooling layer and finally the output from these layers ends up in fully connected layer and it gives the final output from the extracted features.

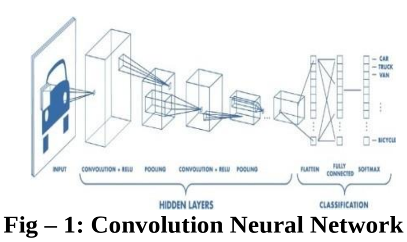

Fig – 1: Convolution Neural Network

The main advantage of CNN over other neural network is that it automatically detects the important features in the given input without human intervention. CNN can also used on 2D or 3D data's too. This network is easy to understand and fast to process and it has higher efficiency when compared with other neural network.

3.1. CONVOLUTION LAYER

Convolutional neural network is the Convolutional layer that gives the network its name. Convolution layer is the layer which converts every one of the pixels in its responsive field into a single value. For instance, when we apply convolution to a image, we will be diminishing the image size i.e., image resizing, just as for acquiring all the data together into a single pixel. The Convolutional neural network, or CNN, is a kind of neural network model, commonly used for working with two-dimensional image, in spite of the fact that they can be utilized with one-dimensional and also three dimensional image. Convolutional layers are the layers where channels are applied to the original image, or to other features in CNN.

3.2. ReLu LAYER

ReLu layer is a function termed as Rectified Linear Unit. It is a simplest non-linearity function achieved by pursuing a linear filter by a non-linear gating function, related identically to every component (point- wise) of a feature map and it will output the input directly if it is positive, otherwise, it will output zero.

3.3. POOLING LAYER

Pooling layer is a building block of CNN. It is used to reduce the spatial dimensions of the given image, thus it reduces the amount of parameter and the computation performed in the network. It summarizes the features or important parameters present in the image that is generated in the convolution layer. The further operations are performed on the important parameters extracted. Pooling is divided into types namely max pooling and average pooling. Max pooling performs the operation that selects the maximum elements from the extracted feature and the final output of max pooling carries the most prominent features of the given input image. Average pooling selects the average elements of the image, whereas max pooling gives prominent and accurate features and the average pooling gives the average features present in the given data set. Global pooling will work on every neuron of the extracted features. Pooling layer will work on each and every feature independently. An usual CNN architecture will have number of convolution layer and pooling layer attached one after the other.

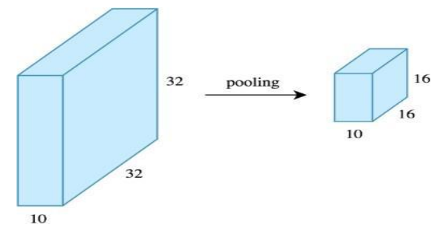

Fig – 2: Pooling layer

3.4. FULLY CONNECTED LAYER:

Fully connected layer is also known as feed forward neural network. It forms the last few layers in CNN. The input that is given to the fully connected later is the output that is given from the convolution layer or pooling layer. Thus, the input to this layer gets flattened. It is one of the major advantage to CNN because; all neurons in one layer are connected to all the neurons in the other layer. This layer is used to perform classification based on the extracted features and gives the representation of the input image. Fully connected layer is also a linear classifier which is used for classification.

4. NOVEL REGULARIZER

In convolution neural network we use regularization technique. Regularization is a technique which makes slight modifications to the learning algorithm which helps to improve the model's performance on the unseen data as well where the complexity of the data is controlled. There are multiple ways to control the complexity for example dropout in neural network or using L1 and L2 regularizer .Here, in this work we have proposed a novel regularizer based standard deviation which is used to reduce the error thereby increasing the performance of neural network by fitting the function appropriately on the given training set and avoids over fitting by randomly discarding some features.

5. PROPOSEDMETHODOLOGY

The main theme of the project is to extract the lesion part in the skin image. This can be achieved by using pre- processing, CNN and post- processing. The feature map is obtained by using kernels. And the back- proportion algorithm is used to enhance the characteristics the input image. Here, the feature map helps to reduce over fitting. The detailed description of the process is explained below

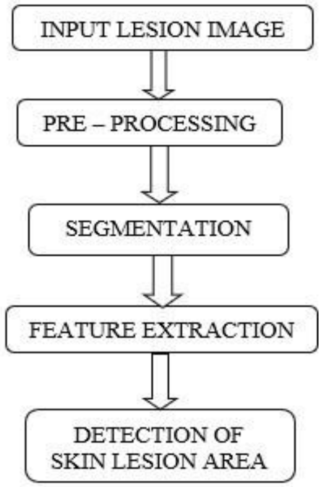

Fig – 3: Block diagram

5.1. INPUT IMAGE

The main aim of this project is to find the skin lesion part in the skin image. We detect the skin lesion part using neural network by Novel Regularizer algorithm. The image used to detect the lesion part is taken from ISIC dataset (International Skin Imaging Collaboration).

5.2. PRE – PROCESSING

The first step is to read an RGB image from dataset and converting them into a grey scale image of resolution 256(0-255). An ISIC dataset image consists of various dimensions. Since some resolution of lesion images requires high cost of computation, it is essential to resize the image for deep learning methods and the image resizing is done in preprocessing stage. This stage also includes image enhancement which improves the quality of image and also filters any unwanted attributes that corrupts the image. The aim of this stage is to eliminate background noise and improve the quality of image by concentrating the focal areas in image.

5.3. SEGMENTATION

The process of segmentation comprises of dividing an input image into parts with identical properties such as level, grey, color, brightness, contrast and texture the role of segmentation is to divide the regions in an image. Hence the region of interest (ROI) is depicted which is nothing but extracting the important features of image using filters. This process is usually done to make boundaries. It is used to isolate the desired part of object from unwanted part.

5.4. FEATURE EXTRACTION

Feature extraction is a process which extracts the specific features in the images from the segmented lesion part which involves in reducing the number of resources required to describe a large set of data and also it identifies the important structures likes point, edges or objects that present in the segmented lesion image to extract the features.

5.5. DETECTION OF LESION PART

Detection is a process which is used for mapping the important features from the given image, the result of saliency detection, where pixel intensity will discriminate the pixel probability that is belonging to salient object. This detection and recognition of dermoscopic images plays a vital role in diagnosing the input image to obtain the final output from the extracted lesion to find whether the skin lesion part is benign or malignant.

6. RESULTS

Fig – 4: Input Image

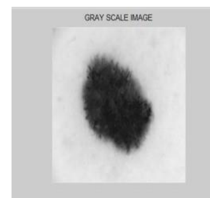

Fig – 5: Gray Scale Image

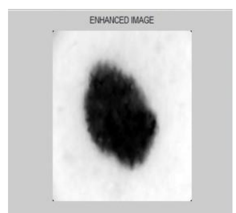

Fig - 6: Enhanced Image

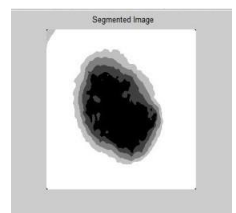

Fig - 7: Segmented Image

Fig - 8: Segmented Lesion

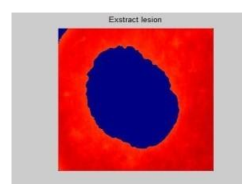

Fig - 9: Extract Lesion

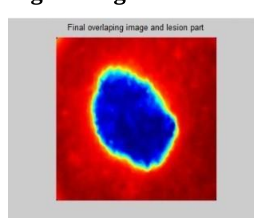

Fig.10 Final Overlapping Image and Lesion part

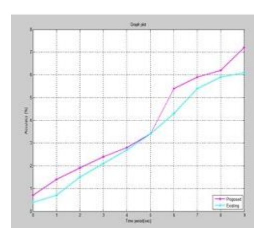

Fig.11Accuracy plot

7. CONCLUSIONS

The main theme of this project is to study the detection of skin lesion with high accuracy, high performance and low complexity. To avoid the low accuracy and high computation time, the Convolution Neural Network is established in this scheme and the result will be detected as malignant and non-tumorous part. Here we use Novel Regularizer algorithm to reduce the complexity and to increase its accuracy. Novel Regularizer also reduces over fitting in the model. CNN comes under the technique of deep learning, which consists of chain feed forward layers and the input image will be processed under four layers of CNN: Convolution layer, ReLu layer, Pooling layer and Fully Connected layer. Database based on ISIC (International Skin Imaging Collaboration). High accuracy is obtained using Novel Regularizer algorithm. Here we detect the lesion part by pre-processing, segmentation, feature extraction and classification method and the results will be obtained in 3D volume i.e., raw pixel value with depth, width and height.

REFERENCES

[1] Masood and A. A. Al-Jumaily, ''Computer aided diagnostic support system for skin cancer: A review of techniques and algorithms,'' Int. J. Biomed. Imag., vol. 2013, Oct. 2013, Art. no. 323268.

[2] E. Waltz, ''Computer diagnoses skin cancers: Deep learning algorithm identifies skin cancers as accurately as dermatologists,'' IEEE Spectr., 2017. Accessed: Dec. 3, 2018.

[3] A. Ali and H. Al-Marzouqi, ''Melanoma detection using regular convolutional neural networks,'' in Proc. Int. Conf. Elect. Comput. Technol. Appl. (ICECTA), Nov. 2017, pp. 1–5.

[4] L. Yu, H. Chen, Q. Dou, J. Qin, and P.-A. Heng, ''Automated melanoma recognition in dermoscopy images via very deep residual networks,'' IEEE Trans. Med. Imag., vol. 36, no. 4, pp. 994–1004, Apr. 2017.

[5] E. Nasr-Esfahani et al., ''Melanoma detection by analysis of clinical images using convolutional neural network,'' in Proc. 38th Annu. Int. Conf. IEEE Eng. Med. Biol. Soc. (EMBC), Aug. 2016, pp. 1373–1376.

[6] Nasr-Esfahani, E., Samavi, S., Karimi, N., Soroushmehr, S. M. R., Jafari, M. H., Ward, K., &Najarian, K. (2016, August). Melanoma detection by analysis of clinical images using convolutional neural network. In 2016 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC) (pp. 1373-1376). IEEE.

[7] Giotis, I., Molders, N., Land, S., Biehl, M., Jonkman, M. F., &Petkov, N. (2015). MED-NODE: a computer-assisted melanoma diagnosis system using non-dermoscopic images. Expert systems with applications, 42(19), 6578-6585.

[8] Mahbod, A., Schaefer, G., Wang, C., Ecker, R., &Ellinge, I. (2019). Skin lesion classification using hybrid deep neural networks. In ICASSP 2019-2019 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP) (pp. 1229-1233). IEEE.

[9] Jaisakthi, S. M., Chandrabose, A., &Mirunalini, P. (2017). Automatic skin lesion segmentation using semi-supervised learning technique. arXiv preprint arXiv:1703.04301.

[10] National Cancer Institute (2013), Skin Cancer Treatment Health Professional Version, Retrieved 2019 from there https://www.cancer.gov/types/skin/hp/skin- treatment-pdq