Melanoma Skin Cancer Classification Using Deep Learning Convolutional Neural Network

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Abstract

In the recent years skin cancer skin cancer is emerging as one of the most complex diseases in which diagnosis is very challenging. Melanoma is generally characterized by the uncontrolled growth of body cells which might be caused due to prolonged exposure to UV rays produced by sun. Skin cancer can be categorized as basal cell carcinoma, squamous cell carcinoma and melanoma among which melanoma is considered as the most difficult to detect and if detected on time, melanoma is curable. Computer vision and Image processing toolboxes plays a pivotal portion in the field of medical imaging and diagnosis and is widely used. This paper focuses on a computer aided tool for skin cancer detection (i.e. melanoma). Dermoscopic images are used as inputs to the CAD system which is subjected to further image processing in which segmentation, feature extraction and classification is done to finally to differentiate between normal and melanoma images.

Keywords: *Skin cancer, Computer Aided Diagnosis, Feature Extraction, Convolutional Neural Network*

Introduction

Cancer is second is the ranked the second cause of worldwide deaths. Cancer is mainly caused by the uncontrolled growth and division of cells. A survey conducted by WHO shos that there are around 9.8 million deaths caused by cancer in the year 2018. Cancer is considered the cause of 1 out of 6 deaths throughout the world. In developing and poor countries (i.e. less and middle level income countries) nearly 70% of deaths are caused due to cancer. The human skin is the largest organ of the integumentary system and outer most covering layer of the body. Immunity which present in human skins plays a vital aspect or role in protecting our human body opposing to pathogens.

Skin cancer can be categorized as basal cell carcinoma, squamous cell carcinoma and melanoma among which melanoma is considered as the most difficult to detect and if detected on time, melanoma is curable. According to the WCRF (World Cancer Research Fund) survey in 2018, melanoma affects both men and women equally and also around 0.3 million of new cases were detected. The top countries which have highest levels of melanoma-skin cancer in 2018 (both male and female) are Australia, New Zealand, Norway, Denmark, Netherland, Sweden, Germany, Switzerland, etc.

Malignant melanoma is caused due to lesser amount of derma tint which is mainly caused by ultra violet (UV) rays from Sun (i.e.) pollution caused due to reduction in ozonosphere and exorbitant exposure to sun. The excessive use of cosmetics, radiation and pollution are major causes of skin cancer. Skin lesions can be categorized as either malignant or begnin based on various external characteristics as the nature of the lesion, whether the lesion is moving and also the size and shape of the lesion.

In paper [1], suggests the image segmentation process is performed based on snake active counter and support vector machine. It will help us to finding the parameters from SVM and Snake algorithm. To make the Snake algorithm effective appropriate selecting of the initial curve and snake parameters is done. The following shapes like rectangle, eclipse and curve are predicted by using the initial curve. In order to decrease the level of complexity, without any deterioration these shapes are chosen to keep the SVM implementation.

In testing the dataset, the images are used for template creation and also to determine the edges based on accuracy. These testing results of snake algorithms will show the finding of edge. To get the good results, segmentation and classification of these algorithms is required.

In paper [2] it describes about the detection the skin cancer from captured images of the affected tumor to determine the tumor is cancerous or normal. Diagnosis of melanoma at an early stage reduces the risk of death. Computer aided techniques will help the dermatologist to find out the skin cancer using image processing. In this work, graph cut algorithm type is used to detect the melanoma from the images and also the features like color, shape and geometry features are extracted from the images using image processing. Based on the extracted features, the images will be classified as malignant or benign stage by support vector machine using radial basis of kernel.

The paper [3] tells about the usage of segmentation of image based on lesion detection using deep learning of pixel wise labeling scheme. The architectural network is used for testing the public data and the ISIC database images are used for training. These results provide good accuracy rate and perform well even in the presence of hair, air and oil bubbles on images. The implementation of this process in GUI gives some additional weightage to the paper.

Paper [4] describes artificial intelligence and image processing techniques for melanoma detection. Image quality levels are improved by eliminating the noise in preprocessing stage. These skin images are segmented by applying the thresholding method. From that the features are extracted by2D wavelet transformation technique. These extracted features were applied as input for artificial neural network of back –propagation based and this method is used to classify their dataset into either cancer or non-cancer.

This paper [5] tells about the JSEG algorithm which was used to diagnose skin cancer by using the lesion boundary method.

In paper [6] the features like color and texture are extracted from gray level co-occurrence matrix (GLCM) and support vector machine (SVM) classifier which are used for classification and further diagnosis of malignant lesions. In this work, an accuracy level of around 90% by was achieved.

In paper [7] explains about the thresholding methods and maximum entropy methods, and these features such as correlations, energy, and unsymmetrical features are obtained from gray level co-occurrence matric [8-10]. And finally, feed forward and artificial neural network method is used for melanoma detection.

Proposed Algorithms:

The algorithm that is being proposed for the diagnosis of skin cancer is explained here.

- DB Image & Category Split/Count
- Load the Pre Trained Network
- Preprocess with CNN features
- Resize the Image & Visualize Weight
- Feature Layer &Train CNN Features by SVM
- Predict the Category with Trained Label
- Predicted Class & Accuracy finding

In our proposed scheme, melanoma classification is done through by using conventional neural network of deep learning technique. Here we are using the pre-trained network model for prediction and classification.

In this work, database contains melanoma and non-melanoma images which are separated from each other for analysis. These database images are split and number of images present in melanoma, non-melanoma is counted by their label or category wise and also the minimum number of images present in each class or type is identified. Then we load the pre-trained network model “Resnet-50” convolution neural network.

Pre-Trained Deep Neural Networks

We extract the powerful and descriptive features which are gathered from natural images using pre-trained image classification network. These pre-trained networks are trained by using the large scale visual recognition challenge using more than 0.001 billion images and then are classified into categories such as animal, car, bus, tea, cup etc.

Resnet-50 (Network Model)

It is also one of the type of pre-trained network model of Conventional neural network, it is trained by more than 0.001 billion images from the Image Net

database. This Resnet-50 pre-trained network which has 50 deep layers, classifies their corresponding database images into categories of 1000 objects. While loading the pre-trained network, it has some properties. In this pre-trained network, from input to output layer which has a huge number of fully connected layers or convolutional layers on path is known as network depth.

After loading the pre-trained network model, we go for image network classification (i.e. identify the prediction class) and preprocess the image on prediction class or label wise by CNN features. After that we resize the (i.e. 224 by 224) and visualize their weightage level. Then we initialize the feature layer of the pre-trained network model.

Feature Extraction in Images on Pre-trained network model

Without time investment and endeavor for complete network training, it's also a simplest and nimble approach for using the capability of deep learning technique. These features are extracted from images by using the pre-trained network and then it's trained by a classifier, like support vector machine (SVM).

Test Image Features & Prediction

Similarly, we can select the test or query image from any of the category in an image data store. We then resize the selected input image as per pre-trained network model (i.e. 224 by 224) and features are extracted from images by using the pre-trained network and then it's corresponding category is predicted by classifier and trained features, test features and trained labels. Finally, the classifier predicts the category and the accuracy rate are calculated from confusion matrix by taking the mean value of diagonal elements of confusion matrix.

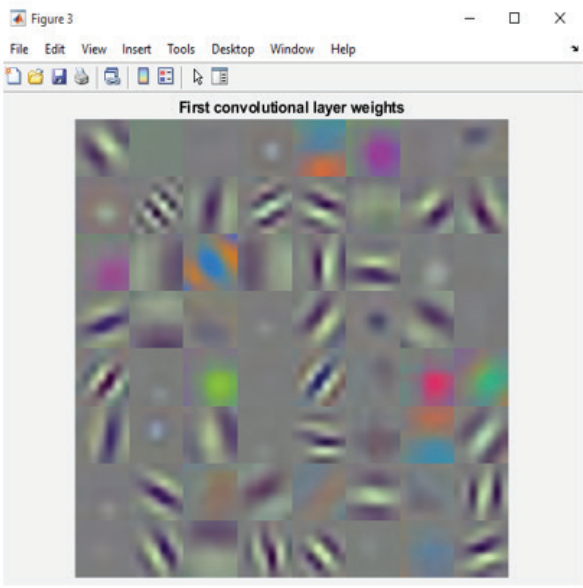

Fig 1: Weighted Matrix

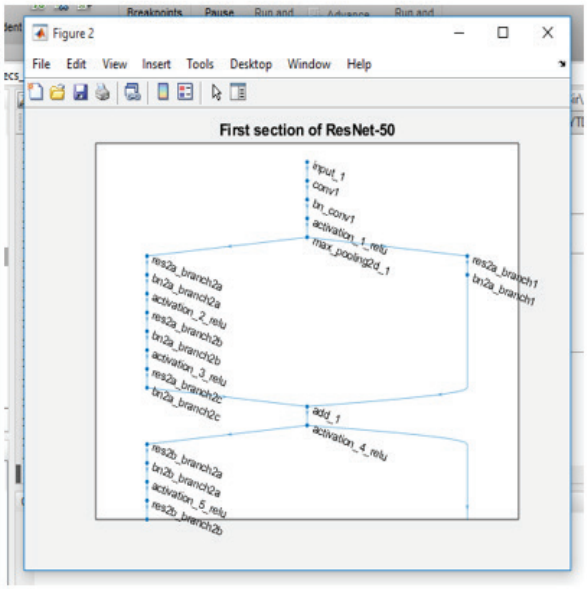

Fig 2: Resnet-50 Layers

Fig 1 & 2, describes about the Resnet50 (pre-trained network model) weightage allocation matrix & Layers connections

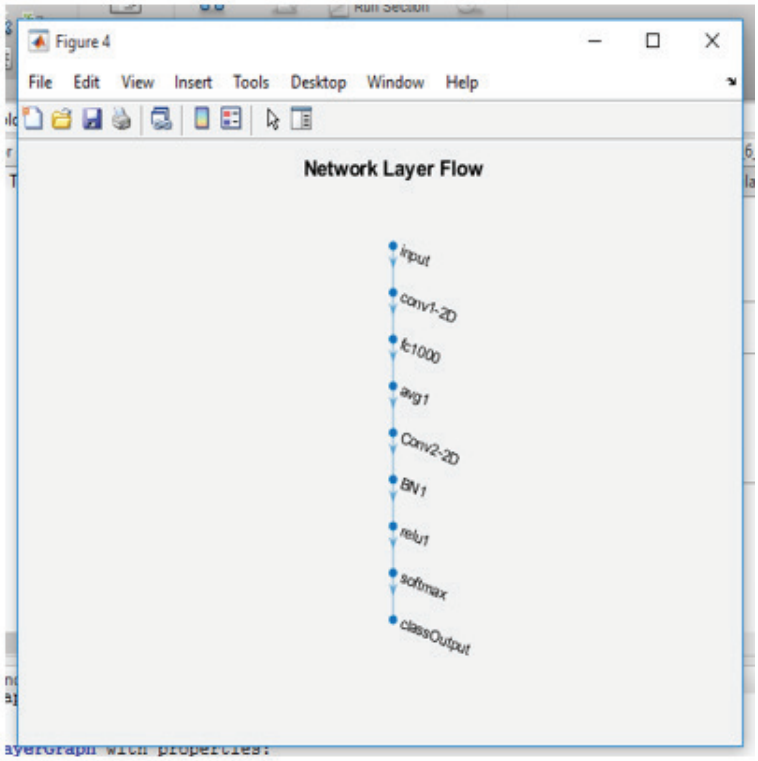

Fig 3: Network – Layer flow

Fig 3 describes about the Network Layer flow & class prediction by using classifier ofResnet50 (pre-trained network model)

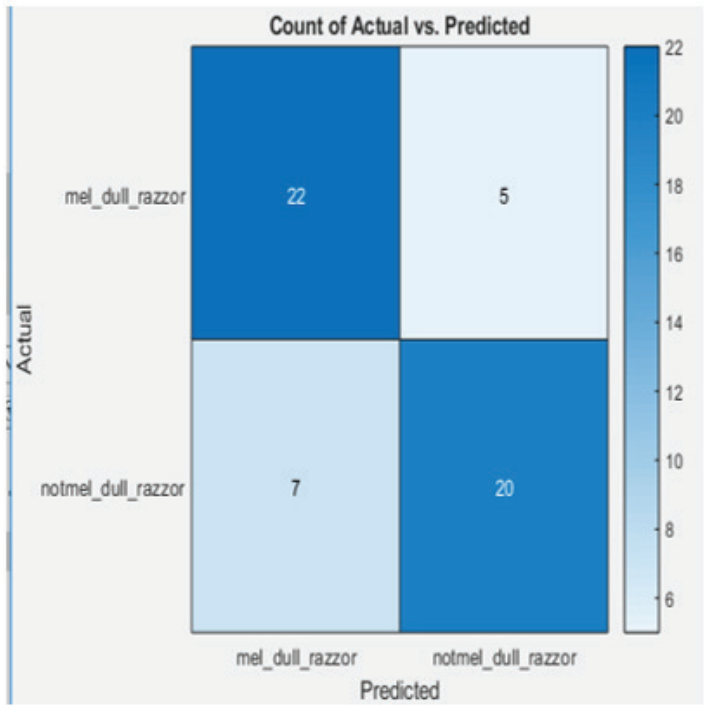

Fig 4: Confusion Matrix

Fig 4, describe about our data prediction level for melanoma skin cancer classification by using Resnet50.

Conclusion

In this work, our aim is to finding the level of skin cancer in human body based on pre-trained network of (Resnet-50-categories of 1000 objects) model and CNN features. And these CNN features dataset and query image features are analyzed and its level is predicted by using deep learning, whether the query image which belongs to which category either melanoma or not. In our pre-trained network model (Resnet-50) getting 85.18 % accuracy. In future, creating the new network model can be done for skin cancer prediction.

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Conflict of Interest: Nil

References

[1] Bumrungkun P, Chamnongthai K, Patchoo W. Detection skin cancer using SVM and snake model. In2018 International Workshop on Advanced Image Technology (IWAIT) 2018 Jan 7 (pp. 1-4). IEEE.

[2] Mustafa S, Kimura A. A SVM-based diagnosis of melanoma using only useful image features. In2018 International Workshop on Advanced Image Technology (IWAIT) 2018 Jan 7 (pp. 1-4). IEEE.

[3] Youssef A, Bloisi DD, Muscio M, Pennisi A, Nardi D, Facchiano A. Deep convolutional pixel-wise labeling for skin lesion image segmentation. In2018 IEEE International Symposium on Medical Measurements and Applications (MeMeA) 2018 Jun 11 (pp. 1-6). IEEE.

[4] Celebi ME, Kingravi HA, Uddin B, Iyatomi H, Aslandogan YA, Stoecker WV, Moss RH. A methodological approach to the classification of dermoscopy images. Computerized Medical imaging and graphics. 2007 Sep 1;31(6):362-73.

[5] Deng Y, Manjunath BS, Shin H. Color image segmentation. InProceedings. 1999 IEEE Computer Society Conference on Computer Vision and Pattern Recognition (Cat. No PR00149) 1999 Jun 23 (Vol. 2, pp. 446-451). IEEE.

[6] Jaleel JA, Salim S, Aswin RB. Computer aided detection of skin cancer. In2013 International Conference on Circuits, Power and Computing Technologies (ICCPCT) 2013 Mar 20 (pp. 1137-1142). IEEE.

[7] Barata C, Ruela M, Francisco M, Mendonça T, Marques JS. Two systems for the detection of melanomas in dermoscopy images using texture and color features. IEEE Systems Journal. 2013 Jul 29;8(3):965-79.

[8] Sonia R. Melanoma image classification system by NSCT features and Bayes classification. International Journal of Advances in Signal and Image Sciences. 2016 Dec 30;2(2):27-33.

[9] Kumarapandian S. Melanoma Classification Using Multiwavelet Transform and Support Vector Machine. International Journal of MC Square Scientific Research. 2018 Sep 28;10(3):01-7.

[10] Manikandan M. SKIN DETECTION UNDER VARYING ILLUMINATION. International Journal of MC Square Scientific Research. 2012 Dec 15;4(1):84-95.