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Detection of Melanoma Skin Cancer using Convolutional Neural Network algorithm

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Abstract*: Skin Cancer, a health issue which might cause severe consequences if not detected and controlled properly. Since there is a huge evolution in the health sector because of development in computer technologies, it is possible to analyze images efficiently and make correct decisions. Deep learning algorithms can be used for analyzing dermoscopic images by learning features of images in an incremental manner. Aim of our proposed method is to categorize skin lesion image as Benign or Melanoma and also to study the performance of Convolutional Neural Network algorithm using data augmentation technique and without data augmentation technique. The proposed method uses dataset from ISIC archive 2019. Steps involved in the proposed method are Image Pre-Processing, Image Segmentation and Image Classification. Initially, Image Pre-Processing algorithm is performed on skin lesion image. Image Segmentation algorithm is used to obtain Region of Interest (ROI) from pre-processed image. Then, Convolutional Neural Network algorithm classifies image as melanoma or benign. The Proposed method can rapidly detect melanoma skin cancer which aids in starting the treatment process without delay.

Keywords: Benign, Convolutional Neural Network, Image Pre-Processing, Image Segmentation, Melanoma, Skin Cancer.

I. INTRODUCTION

Melanoma, a serious type of skin cancer which can further grow to other body parts if not cured at an early stage [1]. It occurs when DNA is damaged due to UV radiation which can result in uncontrolled cellular growth of melanocytes cells [2]. It is the 19th most identified cancer in women and men. There are almost 3, 00,000 new cases in year 2018 [3].The symptoms and signs of melanoma can be identified using ABCDE (Asymmetry, Border, Color, Diameter and Evolving) and the Ugly Duckling Sign [4]. Benign is a non-cancerous form.In general, Skin Cancer is tested using a biopsy method [5], which is a slow process. Thus, an automatic skin cancer detection system can be used to overcome the above stated problem. There are some challenges in analyzing the skin lesion images such as presence of hair, skin lines and ruler marker. These challenges can cause an error in classifying an image [6]. So, an appropriate pre-processing technique is used to overcome the above stated problems.

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Image Segmentation algorithm is used to acquire ROI by removing the healthy part of skin from the image. Then the CNN algorithm is implemented for classification of images. CNN algorithm automatically extracts features from skin lesion image and classifies it as melanoma or benign.

II. RELATED WORK

Youssef Filali, et.al., [6] developed a model which can extract the object and texture elements from an image. Otsu algorithm is applied on object which generates segmented image. Texture is projected on segmented image forming a textural lesion, which is fed to CNN model. The accuracy of their work using CNN on ROI is 93.50%. Amirreza Mahbod, et.al., [7] used three pre-trained deep neural networks such as AlexNet, ResNet-18, VGG16 for feature extraction. The features are used to train support vector machine (SVM). SVM is trained for each pre-trained model and outputs of SVM are combined to get classification result. Khalid M. Hosny, et.al., [8] used a pre-trained AlexNet and transfer learning technique. The accuracy of their proposed method is 80% for original images and 98.61% for augmented images. Marek Wodzinski, et.al., [9] proposed Convolutional Neural Networks using ResNet architecture. The accuracy of proposed system is 87%. Nazia Hameed, et.al.,[10] used pre-trained AlexNet(CNN model) for feature extraction and SVM algorithm for classifying image. Accuracy of their work is 86.21%. Balazs Harangi, et.al., [11] used the collection of deep neural networks constituting CNN's AlexNet, VGGNet, GoogLeNet for skin lesion classification.

III. METHODOLOGY

In this paper, our proposed system aids in automatic classification of skin lesion image into benign or melanoma. Fig. 2 depicts the entire architecture of our suggested methodology.

A. Data Collection

Dataset used for this study are extracted from ISIC 2019 Skin Lesion Analysis towards Melanoma Detection [12]-[14]. It consists of 1000 images of melanoma and benign. Fig. 1 depicts an example each for benign and melanoma. The training data consists of 800 images and testing data consists of 200 images.

(a) (b)

Fig. 1. Examples of images from preferred dataset. (a) Benign (b) Melanoma

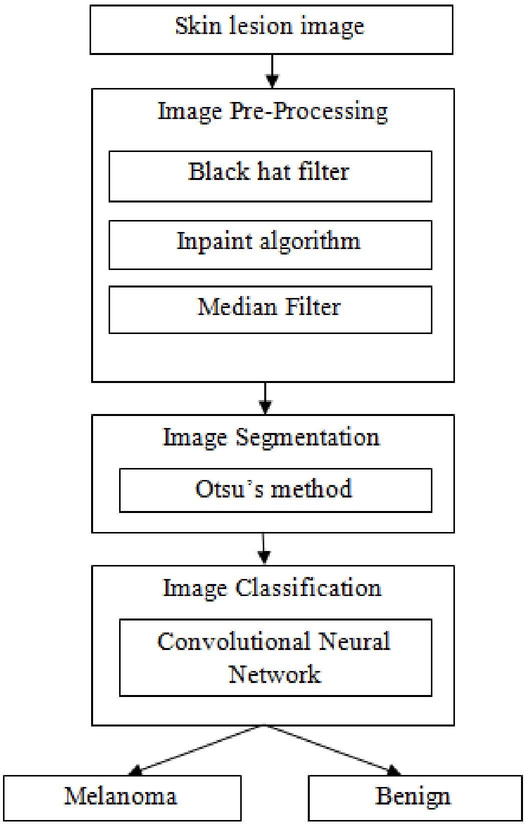

Fig. 2. Proposed system architecture.

B. Image Pre-Processing

RGB image of skin lesion image is converted to grayscale image. Black hat filter is applied on it. This filter is used to enhance objects such as hair, ruler marks in bright background. Thresholding technique is applied on output generated by the filter. Inpaint algorithm takes RGB image of skin lesion and threshold image as input and generates an output image. Then a median filter is applied on this output image to remove noise and generates a pre-processed image. The flowchart of the proposed pre-processing method is illustrated in Fig. 3.

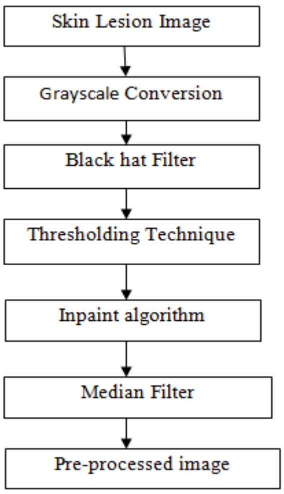

Fig. 3. Flowchart for Image Pre-processing.

Fig. 4 represents outputs generated by applying the above method on image.

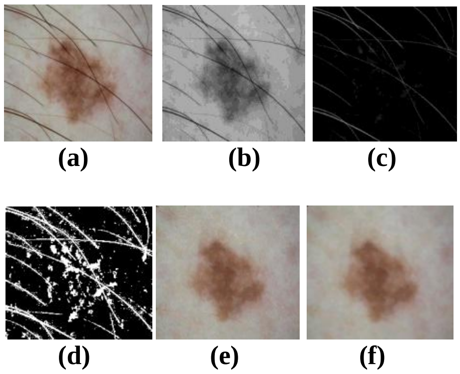

Fig. 4. Pre-processing of benign image:
(a) benign image; (b) grayscale image; (c) Image generated by Black hat filter; (d) Threshold image; (e) output image after inpaint algorithm; (f) Output image generated by median filter

C. Image Segmentation

In this step, pre-processed RGB image is converted into a grayscale image. Then the Otsu's method, a global thresholding technique is used for segmentation. Bi-modal histogram is used to find the threshold value, which can be used to divide pixels of an image into foreground and background. The threshold value is determined such that there is less intra-class variance or more inter-class variance. The output of the Otsu's method is masked upon a pre-processed image and generates a segmented image as output. Fig. 5 represents outputs generated by applying the above method on pre-processed melanoma image.

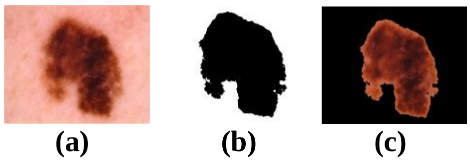

Fig. 5. Image Segmentation of melanoma image
(a) Pre-processed melanoma image
(b) Output of Otsu's method
(c) Segmented image

D. Image Classification

CNN algorithm is used for categorizing skin lesion image into melanoma or benign. It consists of a sequence of several convolutional layers with filters, pooling layers and a fully connected layer. Convolution layer is the initial layer which extracts features from an image. Pooling layer minimizes the size of the activation map. The Max Pooling layer preserves the largest value present in the activation map. Pooled activation maps are flattened to form a feature vector, which is given to fully connected layer. In our proposed methodology, CNN algorithm consists of five convolution layers each with a 3x3 kernel. There are 16 filters, 32 filters, 64 filters, 128 filters, 256 filters in five convolution layers respectively. Max Polling layer with a kernel 2x2 is applied after each convolution layer. Fully connected layer consists of 512 hidden layer nodes and 2 output nodes. The SoftMax activation function is used in the last layer to assign probability value for skin lesion image which aids in classifying image as melanoma or benign.

Procedure involved in our proposed CNN algorithm is shown in Fig. 6.Data augmentation technique is used to increase training dataset by generating modified versions of images. This technique is mainly used to increase the accuracy of CNN model. The different kinds of operations that are performed on dermoscopic images are flip, shear and zoom.

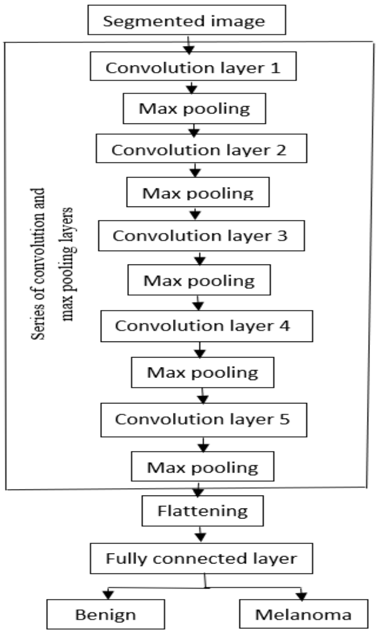

Fig. 6. Procedure involved in our proposed CNN model.

IV. RESULTS

Convolutional neural network model (CNN) is coded in python language using Keras, a neural-network library. In this experiment, accuracy of CNN model is evaluated by considering with data augmentation and without data augmentation technique. The accuracy of the proposed system is shown in Table-I.

Table-I: Accuracy of the Proposed System

Activation Function	Data Augmentation	Accuracy
ReLU	Absent	78.96%
	Present	88.97%

The accuracy of CNN model using Rectified Linear Unit (ReLU) activation function without data augmentation is 78.96%. The accuracy of CNN model using ReLU activation function with data augmentation is 88.97%.

V. CONCLUSION

In the proposed system, Image Pre-Processing, Image Segmentation and Image Classification steps are performed for categorizing skin lesion images into melanoma or benign. Data augmentation technique is used in Convolutional Neural Network for increasing the number of images which leads to better performance of the proposed method. Experimental results show that accuracy of CNN algorithm developed with data augmentation is higher than the CNN algorithm created without data augmentation. The proposed method detects melanoma faster than the biopsy method. The proposed method can be extended to identify different types of skin related diseases.

REFERENCES

1. What Is Melanoma Skin Cancer? https://www.cancer.org/cancer/melanoma-skin-cancer/about/what-is-melanoma.html, accessed date: Mar 30,2020.
2. Melanoma Overview, http://www.skincancer.org/skin-cancer-information/melanoma/, accessed date: Mar 30,2020.
3. Skin cancer statistics, https://www.wcrf.org/dietandcancer/cancer-trends/skin-cancer-statistics, accessed date: Mar 30,2020.
4. Signs and Symptoms of Melanoma Skin Cancer, https://www.cancer.org/cancer/melanoma-skin-cancer/detection-diagnosis-staging/signs-and-symptoms.html, accessed date: Mar 30,2020.
5. Tests for Melanoma Skin Cancer, https://www.cancer.org/cancer/melanoma-skin-cancer/detection-diagnosis-staging/how-diagnosed.html, accessed date: Mar 30, 2020.
6. Youssef Filali, Hasnae El Khoukhi, My Abdelouahed Sabri, Ali Yahyaouy , Abdellah Aarab,"Texture Classification of skin lesion using convolutional neural network", IEEE, International Conference on Wireless Technologies, Embedded and Intelligent Systems (WITS),DOI:10.1109/WITS.2019.8723791,2019.
7. Amirreza Mahbod, Gerald Schaefer, Chunliang Wang, Rupert Ecker, Isabella Ellinger, "Skin Lesion Classification Using Hybrid Deep Neural Networks", IEEE, International Conference on Acoustics, Speech and Signal Processing (ICASSP), pp.1229-1233,2019.
8. Khalid M. Hosny, Mohamed A. Kasseem , Mohamed M.Foaud, "Skin Cancer Classification using Deep Learning and Transfer Learning", IEEE, 9th Cairo International Biomedical Engineering Conference (CIBEC), pp.90-93, 2018.
9. Marek Wodzinski, Andrzej Skalski, Alexander Witkowski, Giovanni Pellacani, Joanna Ludzik, "Convolutional Neural Network Approach to Classify Skin Lesions Using Reflectance Confocal Microscopy", IEEE, 41st Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC) ,pp.4754-4757, 2019.
10. Nazia Hameed, Antesar M. Shabut, M.A. Hossain, "Multi-Class Skin Diseases Classification Using Deep Convolutional Neural Network and Support Vector Machine", IEEE, 12th International Conference on Software, Knowledge, Information Management & Applications (SKIMA), DOI:10.1109/SKIMA.2018.8631525, 2018.
11. Balazs Harangi, Agnes Baran , Andras Hajdu, "Classification of Skin Lesions Using An Ensemble of Deep Neural Networks", IEEE, 40th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC), pp.2575-2578, 2018.
12. Tschandl P., Rosendahl C. & Kittler H. The HAM10000 dataset, a large collection of multi-source dermatoscopic images of common pigmented skin lesions. Sci. Data 5, 180161 doi.10.1038/sdata.2018.161 (2018).
13. Noel C. F. Codella, David Gutman, M. Emre Celebi, Brian Helba, Michael A. Marchetti, Stephen W. Dusza, Aadi Kalloo, Konstantinos Liopyris, Nabin Mishra, Harald Kittler, Allan Halpern: "Skin Lesion Analysis Toward Melanoma Detection: A Challenge at the 2017 International Symposium on Biomedical Imaging (ISBI), Hosted by the International Skin Imaging Collaboration (ISIC)", 2017; arXiv:1710.05006.
14. Marc Combalia, Noel C. F. Codella, Veronica Rotemberg, Brian Helba, Veronica Vilaplana, Ofer Reiter, Allan C. Halpern, Susana Puig, Josep Malvehy: "BCN20000: Dermoscopic Lesions in the Wild", 2019; arXiv:1908.02288.

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