FOREX Publication
Open Access | Rapid and quality publishing

International Journal of
Electrical and Electronics Research (IJEER)
Research Article | Volume 10, Issue 4 | Pages 984-987 | e-ISSN: 2347-470X

Skin Cancer Detection and Segmentation Using Convolutional Neural Network Models

Swetha S[1], S. Saranya[2] and M. Devaraju[3]

[1]*PG Scholar, Communication Systems, Easwari Engineering College, Chennai, India-60008, swethasenthil98@gmail.com*
[2]*Assistant Professor, Electronics and communication, Easwari Engineering College, Chennai, India-600089, saranya.s@eec.srmrmp.edu.in*
[3]*Professor, Electronics and communication, Easwari Engineering College, Chennai, India-600089 hod.ece@eec.srmrmp.edu.in*

***Correspondence:** Swetha S; swethasenthil98@gmail.com

ABSTRACT- Skin cancer is known as one of the killing diseases in humans around the world. In this paper, melanoma skin cancer images are classified and the cancer regions are segmented using Convolutional Neural Networks (CNN). The skin images are data augmented into high number of skin images for obtaining the high classification accuracy. Then, CNN classifier is used to classify the skin image into either melanoma or normal. Finally, morphological segmentation method is used to segment the cancer regions. The simulation results are obtained by applying the proposed methods on ISIC and HAM dataset skin images.

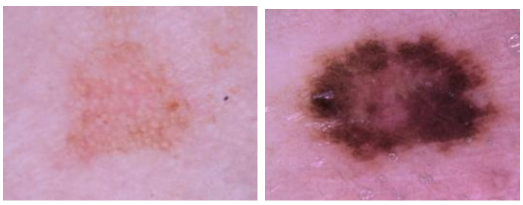
Keywords: Skin, cancer, melanoma, CNN, segmentation.

ARTICLE INFORMATION
Author(S): Swetha S, S Saranya, M Devaraju;
Received: 31/03/2022; **Accepted:** 06/06/2022; **Published:** 12/11/2022;
E- ISSN: 2347-470X;
Paper Id: IJEER220331;
Citation: 10.37191/IJEER.100438
Webpage-link:
https://ijeer.forexjournal.co.in/archive/volume-10/ijeer-100438.html

Publisher's Note: FOREX Publication stays neutral with regard to jurisdictional claims in Published maps and institutional affiliations.

1. INTRODUCTION

The cancer can be formed in any part of the human body due to genetic reasons and other malfunction of the cells. Among these types of cancers formed in human, skin cancer is identified as most crucible type cancer which sometimes leads to death. Most methods for skin cancer identification are presently based on the biopsy approach which consumed more time period to detect and locate the cancer regions in skin images. But, it is cost effective and the cancer regions can be cured if it is detected or identified through the biopsy procedure. Melanoma is the important type of skin cancer in human body which can be cured if it is identified in its earlier stage. This melanoma skin cancer is classified into benign type melanoma and malignant type melanoma. Among those types of cancer, malignant type melanoma skin cancer is very important and also known as deadliest cancer. The benign type melanoma skin cancer can be easily identified without biopsy set of procedures. It can be screened by analyzing the skin patterns and color of the skin patches, see *figure1 (a), 1(b)*.



1(a) 1(b)
Figure 1: (a) Healthy skin image (b) Melanoma affected skin image

At present, many computer based approaches are developed and used by the physicians to identify the skin cancer images. These computer based approaches used soft computing methods to locate the cancer regions. In this work, deep leaning neural network model such as Convolutional Neural Networks (CNN) are used to identify the skin cancer affected images.

2. LITERATURE SURVEY

Shi Wang et al. (2021) used thermal image optimization process to determine the thermal properties of the skin image. Then, Extreme Machine Learning (EML) algorithm was used to find the cancer affected skin images using the computed thermal properties. The authors validated their developed skin cancer detection method on open access ISIC dataset. The simulation results were compared with other skin cancer detection models in this paper to validate the effectiveness of the skin cancer identification process. Xu et al. (2020) used soft computing methods for detecting the cancer regions in skin images. The authors tested their developed skin cancer detection models with various soft computing algorithms to verify the effectiveness of the developed model. The developed skin cancer detection model was applied and tested with various set of skin images which obtained 96% of overall skin cancer classification results. Zhang et al. (2020) modified the CNN architecture model using the optimization parametric approach. This constructed Optimized CNN (OCNN) model was used to classify the skin images into either normal or cancer images. This OCNN classification model was constructed with less number of internal layers and internal features which optimized the skin cancer classification rate.

Esteva et al. (2017) used deep neural networking algorithms for identifying the cancer affected skin images. This dermatologist-level based significant non-linear classification system improved the skin image classification rate. This deep neural networking algorithm obtained 91% of skin cancer classification rate along with 96.1% of sensitivity rate and

FOREX Publication
Open Access | Rapid and quality publishing

International Journal of
Electrical and Electronics Research (IJEER)
Research Article | Volume 10, Issue 4 | Pages 984-987 | e-ISSN: 2347-470X

97.1% of specificity rate. The simulation results of the developed deep neural networking algorithms for skin cancer detection system were compared with other similar models. Pennisi et al. (2016) used delaunay triangulation approach for melanoma skin cancer detection. This approach used less optimization metric parameters for the classification of skin cancer images. In addition, the segmented cancer regions were also diagnosed for severity estimation. The developed skin cancer detection model was applied and tested with various set of skin images which obtained 96% of overall skin cancer classification results.

3. PROPOSED SKIN CANCER DETECTION METHODS

In this work, the skin images are classified using data augmentation and CNN classifier. *Figure 2* is the generic melanoma skin cancer detection system and *figure 3* is the VGG-16 design for classifications for melanoma skin cancer.

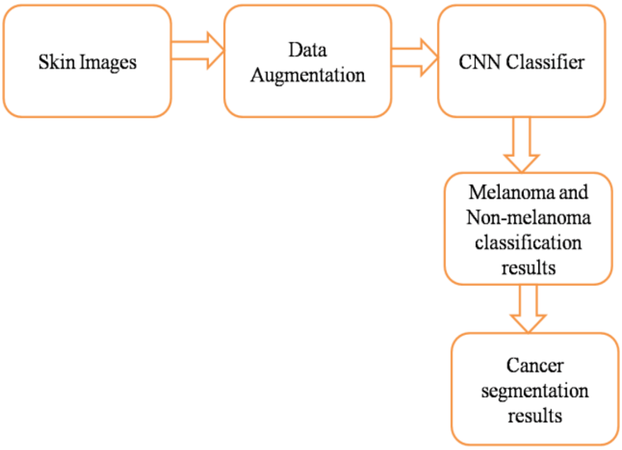


Figure 2: Generic melanoma skin cancer detection system

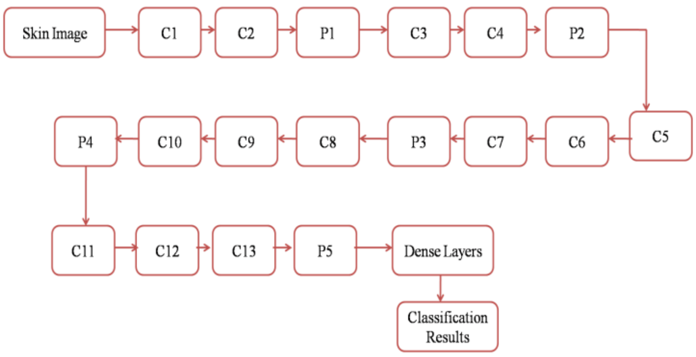


Figure 3: VGG-16 design for classifications

3.1 Data Augmentations

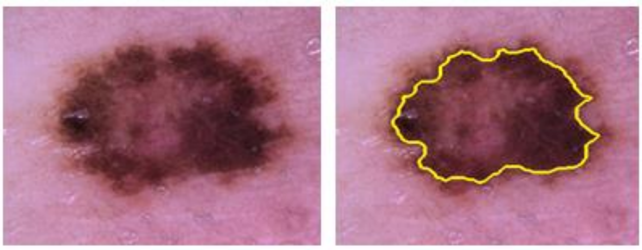
The VGG-deep learning system requires more number of trained skin images for the effective classifications. Hence, there is a need for the data augmentation methods to improve the number of trained skin images. In this regard, linear pixel shift operations such as left and right pixel shift functions are employed on the skin images which increase the current image counts in the database. These improved number of skin cancer images also increases the cancer detection accuracy. Therefore, such methods are included as one of the preprocessing methods before the CNN classifier for the classifications of skin cancer images.

3.2 VGG-16 classifier

The data augmented number of skin images are fed into the VGG-16 classifier for the effective classification of the skin images. Even though lot of deep learning classifiers available in skin classification system, VGG-16 classifier is preferred in this paper to classify the source skin image into either melanoma or non-melanoma case. In general architecture of CNN classifier, there are three important modules available as Convolutional layer (C), Pooling layer (P) and dense layers. The function of the C layer is to perform the linear multiplication of the source skin image and the filter kernel which is designed with each C layer in this CNN architecture. The output response of the C layer is high which significantly reduces the output results and increases the computational complexity of the design. Therefore, it is important to reduce the time computational complexity of the entire architecture. This is possible by adopting P layer at the end of each C layers. In this work, max functioning or operation is involved in P layer in order to reduce the computational complexity of the design. Finally, the pooled responses are sent to the set of dense layers for obtaining the classification results. In this work, 13 C layers and 5 P layers and 3 dense layers are used to construct the VGG-16 classification system. The final classification results are produced based on the following constraints.

$$Skin\ image\ type = \begin{cases} Normal\ skin\ image;\ if\ dense\ output = 0 \\ Malenoma\ skin\ image;\ if\ dense\ output > 0 \end{cases}$$

The morphological threshold functions are further used to locate the cancer pixels in the melanoma skin image. *Figure 4* (a) is the Melanoma skin cancer affected image and *figure 4(b)* is the cancer identified image by proposed method.



(a) (b)

Figure 4: *(a)* Melanoma skin cancer affected image *(b)* Cancer identified image by proposed method

4. RESULTS AND DISCUSSIONS

In this paper, International Skin Imaging Collaboration (ISIC) database is used to apply the proposed melanoma skin cancer identification methods. The melanoma skin cancer images and non-melanoma skin cancer images are presently available at https://www.isicarchive.com/#!/topWithHeader/wideContentTop/main. This database is fully open access and it does not require any license to use the skin images around the world. From the total number of 69445 melanoma skin cancer images, 5000 melanoma skin cancer images and 7000 non-melanoma images are used in this paper. The 5000 melanoma skin cancer images are split into 2500 images for training and 2500 images for testing the proposed work in this paper. The 7000 non-melanoma skin cancer images are split into 3500 images for training and 3500 images for testing the proposed work in this paper. In this work, training – testing ratio of the database images is 50:50. The skin images in this dataset are having the pixel bit depth about 8 and the size of the image is about 512*512 pixels.

This work uses the parameters precision, recall and F1 score to analyze the proposed melanoma skin lesion image detection as described in the following equations.

$$Precision\ (P) = \frac{TP}{TP + FP}$$

$$Recall\ (R) = \frac{TP}{TP + FN}$$

$$F1 - Score\ (FS) = \frac{2 * P * R}{P + R}$$

The positively identified cancer and non-cancer pixels are denoted by TP and TN respectively. The non-positively identified cancer and non-cancer pixels are denoted by FP and FN respectively.

The melanoma skin cancer detection system stated in this work is applied on two open access database ISIC and HAM10000. The experimental results are stated in the following tables.

All these parameters used in this work are measured in % and they are tabulated in the following *Table 1*. *Table 1* and in *figure 5* is the experimental analysis of proposed melanoma skin cancer detection system on ISIC skin image database. The melanoma cancer detection approach obtains 97.12 % of P, 98.17% of R and 98.85% of FS on ISIC dataset skin images.

Table 1. Experimental analysis of proposed melanoma skin cancer detection system on ISIC skin image database

Melanoma image sequence	Precision (P)%	Recall (R)%	F1-Score (FS)
Melanoma image sample 1	97.2	98.7	98.1
Melanoma image sample M2	97.3	97.9	99.5
Melanoma image sample M3	93.9	97.4	99.3
Melanoma image sample M4	98.1	98.7	99.6
Melanoma image sample M5	97.9	93.7	97.9
Melanoma image sample M6	97.3	98.6	99.1
Melanoma image sample M7	98.6	99.1	99.3
Melanoma image sample M8	97.6	98.6	98.6
Melanoma image sample M9	96.9	99.6	98.6
Melanoma image sample M10	96.4	99.4	98.5
Average	**97.12**	**98.17**	**98.85**

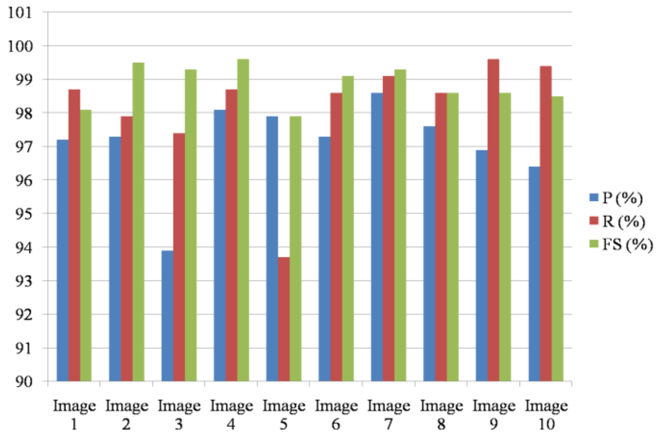


Figure 5: Experimental analysis on ISIC skin image database

Table 2 and figure 6 is the experimental analysis of proposed melanoma skin cancer detection system on HAM10000 skin image database.

Table 2. Experimental analysis of proposed melanoma skin cancer detection system on HAM10000 skin image database

Melanoma image sequence	Precision (P)%	Recall (R)%	F1-Score (FS)
Melanoma image sample 1	98.6	99.3	99.5
Melanoma image sample M2	98.7	99.1	99.5
Melanoma image sample M3	99.3	98.6	99.3
Melanoma image sample M4	99.5	99.5	99.6
Melanoma image sample M5	98.9	98.6	99.3
Melanoma image sample M6	98.5	98.6	99.8
Melanoma image sample M7	99.1	99.1	99.3
Melanoma image sample M8	99.9	99.1	98.6
Melanoma image sample M9	99.5	99.6	98.6
Melanoma image sample M10	99.1	99.4	99.3
Average	**99.11**	**99.09**	**99.28**

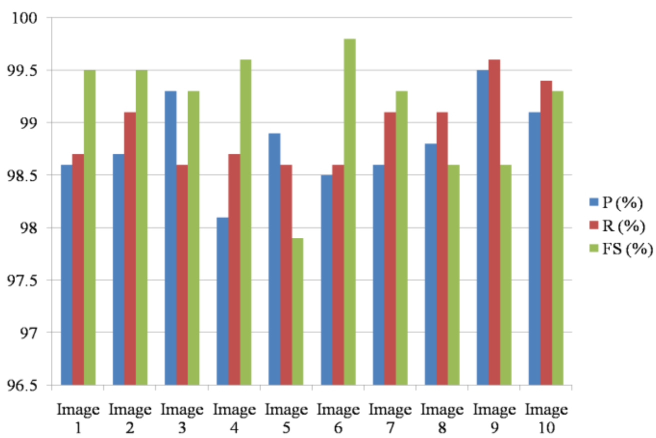


Figure 6: Experimental analysis on HAM10000 skin image database

Table 3 is the comparative works for melanoma skin cancer detection on ISIC dataset, which compares the proposed method with other methods.

Table 3. Comparative works for melanoma skin cancer detection on ISIC dataset

Author details	Methods	Precision (%)	Recall (%)	F1-Score (%)
This paper	CNN	97.12	98.17	98.85
Shi Wang et al. (2021)	Extreme Learning Machine	91.18	89.7	92.65
Das et al. (2020)	Fusion approach	82.35	76.47	83.82
Alquran et al. (2017)	Support Vector Machine (SVM)	83.82	76.47	83.82

Table 4 is the comparative works for melanoma skin cancer detection on HAM10000 dataset, which compares the proposed method with other methods.

Table 4. Comparative works for melanoma skin cancer detection on HAM10000 dataset

Author details	Methods	Precision (%)	Recall (%)	FS (%)
This paper	CNN	**99.11**	**99.09**	**99.28**
Shi Wang et al. (2021)	Extreme Learning Machine	91.18	89.7	92.65
Das et al. (2020)	Fusion approach	82.35	76.47	83.82
Alquran et al. (2017)	SVM	83.82	76.47	83.82

5. CONCLUSION

In this work, the skin images are classified using data augmentation and CNN classifier. The skin images are data augmented into high number of skin images for obtaining the high classification accuracy. Then, CNN classifier is used to classify the skin image into either melanoma or normal. Finally, morphological segmentation method is used to segment the cancer regions. The melanoma skin cancer detection system stated in this work is applied on two open access database ISIC and HAM10000. The melanoma cancer detection approach obtains 97.12 % of Precision, 98.17% of Recall and 98.85% of F1-Score on ISIC dataset skin images. The melanoma cancer detection approach obtains 99.11% of Precision, 99.09% of Recall and 99.28% of F1-Score on HAM10000 dataset skin images.

6. ACKNOWLEDGMENTS

Thanks to co-authors for their involvement in the manuscript. Our sincere thanks to our parents for their constant support.

REFERENCES

[1] R. Dobrescu, M. Dobrescu, S. Mocanu, and D. Popescu, “Medical images classification for skin cancer diagnosis based on combined texture and fractal analysis,” WISEAS Transactions on Biology and Biomedicine, vol. 7, no. 3, pp. 223–232, 2010.

[2] C. Salem, D. Azar, and S. Tokajian, “An image processing and genetic algorithm-based approach for the detection of melanoma in patients,” Methods of Information in Medicine, vol. 57, no. 1, pp. 74–80, 2018.

[3] R. Das, S. De, S. Bhattacharyya, J. Platos, V. Snasel, and A. E. Hassanien, “Data augmentation and feature fusion for melanoma detection with content based image classification,” in Proceedings of the International Conference on Advanced Machine Learning Technologies and Applications, Cairo, Egypt, January 2020.

[4] H. Alquran, I. A. Qasmieh, A. M. Alqudah et al., “The melanoma skin cancer detection and classification using support vector machine,” in Proceedings of the 2017 IEEE Jordan Conference on Applied Electrical Engineering and Computing Technologies (AEECT), IEEE, Aqaba, Jordan, October 2017.

[5] N. Zhang, Y.-X. Cai, Y.-Y. Wang, Y.-T. Tian, X.-L. Wang, and B. Badami, “Skin cancer diagnosis based on optimized convolutional neural network,” Artificial Intelligence in Medicine, vol. 102, Article ID 101756, 2020.

[6] Esteva, B. Kuprel, R. A. Novoa et al., “Dermatologist-level classification of skin cancer with deep neural networks,” Nature, vol. 542, no. 7639, pp. 115–118, 2017.

[7] Shi Wang, Melika Hamian, "Skin Cancer Detection Based on Extreme Learning Machine and a Developed Version of Thermal Exchange Optimization", Computational Intelligence and Neuroscience, vol. 2021, Article ID 9528664, 13 pages, 2021.

[8] Z. Xu, F. R. Sheykhahmad, N. Ghadimi, and N. Razmjooy, “Computer-aided diagnosis of skin cancer based on soft computing techniques,” Open Medicine, vol. 15, no. 1, pp. 860–871, 2020.

[9] Pennisi, D. D. Bloisi, D. Nardi, A. R. Giampetruzzi, C. Mondino, and A. Facchiano, “Skin lesion image segmentation using delaunay triangulation for melanoma detection,” Computerized Medical Imaging and Graphics, vol. 52, pp. 89–103, 2016.

[10] ISIC dataset: https://www.kaggle.com/nodoubttome/skin-cancer9-classesisic

[11] HAM dataset: https://www.kaggle.com/kmader/skin-cancer-mnist-ham10000