International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2019): 7.583

Detection and Classification of Skin Cancer using Image Processing Techniques

Maha Shawish[1], Balsam Eid[2]

[1]Thesis student, Department of Mechanical and Electrical Engineering, Tishreen University, Lattakia, Syria

[2]Assosiate Professor, Department of Mechanical and Electrical Engineering, Tishreen University, Lattakia, Syria

Abstract: ***Skin cancer is one of the most common cancers, and early detection of it helps in reducing the rate of disease spread and reducing the mortality rate. In this paper, a database of skin cancer pictures was collected consisting of 164 images. All of them belong to people of different ages, sex, and color, and the difference in the background and distance from the camera and the position of the mole was taken into consideration. The images were processed by histogram equalization, and some image processing techniques were applied to obtain the Region Of Interest (ROI) area. The color of the ROI area was also relied on to extract the features, as these colors were used as input for a simple color classifier using Matlab program, as this classifier was able to distinguish between the four basic types in the proposed system.***

Keywords: Skin Cancer, Feature Extraction, Image Processing Techniques, Computer-Aided-Diagnosis, Melanoma, Histogram equalization

1. Introduction

Skin cancer is the most common type of cancer. Thankfully, unlike most cancers, you can see the cancer before it becomes dangerous and spreads to other parts of the body. Also important is the fact that when detected early, almost all cases of skin cancer can be completely cured. There are two main types of skin cancer: melanoma and non-melanoma. The most common non-melanoma tumors are basal cell carcinoma and squamous cell carcinoma [1].

Melanoma of the skin is the 19th most commonly occurring cancer in men and women. There were nearly 300,000 new cases in 2018 [2].

Australia had the highest rate of melanoma in 2018, followed by New Zealand [2].

The incidence of both non-melanoma and melanoma skin cancers has been increasing over the past decades. Currently, between 2 and 3 million non-melanoma skin cancers and 132,000 melanoma skin cancers occur globally each year. One in every three cancers diagnosed is a skin cancer and, one in every five Americans will develop skin cancer in their lifetime.

Non-melanoma skin cancer is the 5th most commonly occurring cancer in men and women, with over 1 million diagnoses worldwide in 2018, although this is likely to be an underestimate [3].

The ABCD rule (E) was developed by the American Center for the Study of Dermatology, to identify melanoma [4,5,6] and Fig1 shows the ABCD rule (E):

1) Asymmetry (A): Asymmetry of skin moles between the left and right sides.
2) Border (B): The edges of moles are fuzzy and irregular.
3) Color. Color (C): The presence of a variety of colors or a mole that is not uniform in color.
4) Diameter (D): To be larger than 6mm in diameter.
5) Evolving (E): It is possible for a mole to enlarge or change its shape over time.

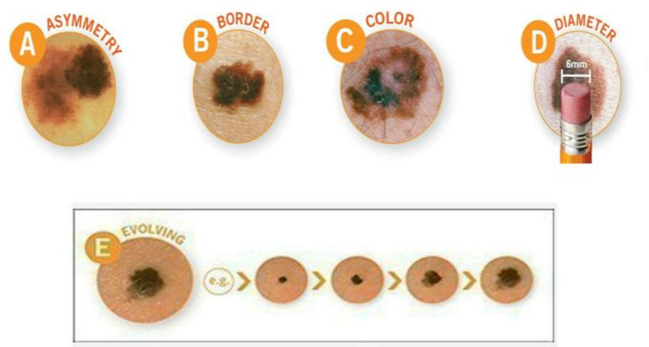

Figure 1: ABCDE Rule

With the development of medical imaging techniques because of developments in various computer fields, a gap appeared between what these technologies provide in terms of medical data that contain accurate and important information and the capabilities of limited human elements to analyze this information, which prompted the search for computer solutions that help in the diagnostic process.

The use of computer systems in this field has become an important matter because it will give more accurate results that help to improve results and reduce the error rate, which could help save human lives.

Computer-aided detection, also called computer-aided diagnosis, are systems that assist doctors in the interpretation of medical image.

This paper is presents algorithms for detection of skin cancer. It consists of three stages wherein first stage the area of the moles is determined and in the second stage, we extract features that will be relied upon classification while in the third stage the mole is classified as a Benign or SCC or BCC or Melanoma.

Licensed Under Creative Commons Attribution CC BY

2. Related Works

In 2010, the researcher Suhail M. Odeh [7] conducted a study entitled, "Using the Adaptive Neuro-Adaptive Inference System (ANFIS) algorithm for automatic diagnosis of skin cancer," database contained 100 images, this study focused on using 6 features. These works were selected using the Greedy feature flip algorithm. The output classification into actinic keratosis and BCC, this system performed well with a classification accuracy rate of 92.35%.

In 2011, Bareqa Salah, Mohamed Al-Sharidah, Rasha Beidas, and Ferial hayajneh [8] studied the identification of skin cancer recognition by using a neuro-fuzzy system. The classification was classified into several types of melanoma and several types of non-melanoma and 58 database images were used. The classification accuracy rate is 90.67%, while the rate when using NN and Neuro-fuzzy together became 91.26% as we did not notice significant results.

In 2015, Amruta M. Gajbar and Prof. A. S. Deshpande [9], with a study entitled" Detection And analysis of skin cancer in skin lesions by using segmentation", where 5 features (contrast, correlation, energy, homogeneity, and standard deviation) were extracted and used as input to grayscale co-occurrence matrix (GLCM) algorithm, and there were be able to classify output to Basal cell carcinoma and melanoma.

In 2015 V. Jeya Ramya, J. Navarajan, R. Prathipa, and L. Ashok Kumar [10] conducted a study entitled " Detection of melanoma skin cancer Using Digital Camera Images' in which the same algorithm was used in the previous study, but the output was classified into a benign mole and melanoma.

In 2015 Omkar Shridhar Murumkar and Prof. Gumaste PP [11] with a study entitled "Feature extraction for skin cancer lesion detection", in which they made use of the ABCD rule developed by the American Cancer Society to identify melanoma. The values of the four characteristics were extracted: Asymmetry, Border, Color, Diameter, and then TDV is calculated by the formula:

$$TDV = A\ 1.3 + B \cdot 0.1 + C\ 0.5 + D \cdot 0.5 \quad (1)$$

By the TDV value, the output is classified into a benign mole, suspected mole, or melanoma.

In 2015 Siddiq Iqbal, Sophia.M, Divyashree.JA, Mallikarjun Mundas, and Vidya. R [12] conducted a study entitled "Implementation of supervised learning for melanoma detection using image processing" where the same algorithm was used but the diameter value was replaced by Minor and Major axis, based on, Therefore, the output was classified into a benign mole and melanoma, which achieved satisfactory results and good classification accuracy rate of 92%.

3. Proposed System

Computer aided melanoma detection system using color classification is proposed in this work. The proposed methodology for detection and classification of skin cancer is shown in Fig2.

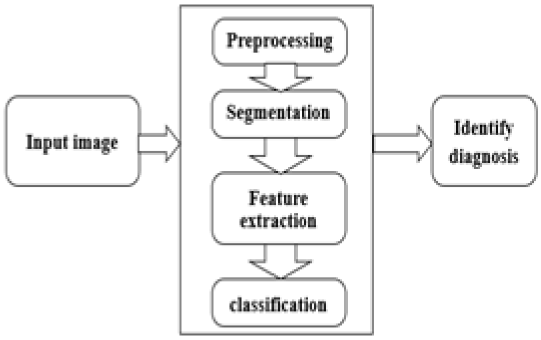

Figure 2: Proposed System

Image Acquisition

In this step we choose the image that we want to classify from database (Image number 1 in database is shown in Fig 3). This database contains 164 images divided into:

- 21 photos of a benign mole.
- 19 photos of SCC mole.
- 31 photos of a BCC mole.
- 93 photos of a melanoma mole.

Database has the following characteristics:

- Different places where moles are placed.
- The different sizes of moles.
- The presence of more than one mole in some of the pictures.
- Different image sizes.
- The distance difference from the camera.
- Different skin color.
- The presence of hair in most of the images.

Figure 3: Skin lesion input image

Preprocessing:

The stages of preprocessing are shown in a Fig 4.

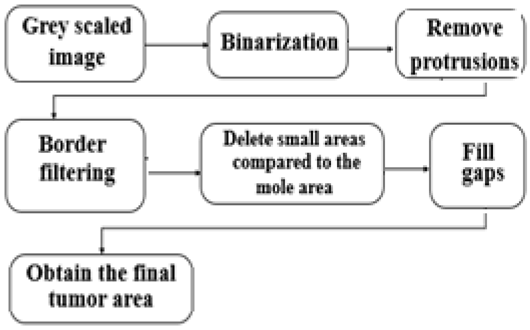

Figure 4: Preprocessing stages

Licensed Under Creative Commons Attribution CC BY

This stage includes the following sub-steps:
1) Converting the image to grayscale.
2) Applying the histogram equalization process to the image to increase its contrast and to make the tumor area more and more different from its neighborhood.

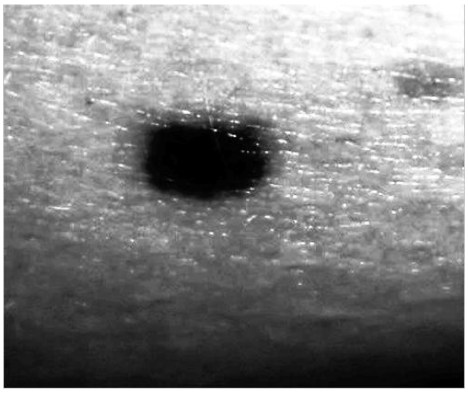

Figure 5: Preprocessing image

Segmentation:
1) Convert the gray image into a binary image
2) Remove the protrusions that may appear in the image by performing an opening process.

Figure 6: Binarization image

3) We note here that the image resulting will include the tumor area and other noisy areas so remove pixels stuck on the borders

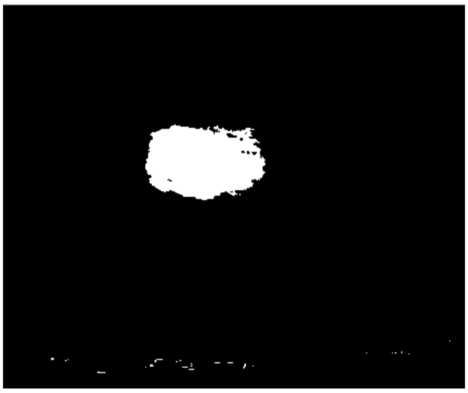

Figure 7: Border filtering image

4) The image resulting from the border filtering process is addressed to convert it into an untitled image consisting of a group of connected regions, and each region has its own number.
5) We calculate the area with the largest size because it will represent the tumor area.

Figure 8: Largest size mole

6) We now delete all areas whose size is less than a quarter of the size of this larger area, and the reason that we took the size of the largest area as a criterion is that the size of the tumor area may differ from one image to another, and therefore the calculation of the largest area in the image makes the deletion process differ according to the image studied Thus, the algorithm remains correct, regardless of the size of the tumor.
7) Fill the gaps: we apply the morphological close process that fills these gaps.

Figure 9: Fill gaps image

8) And now it remains for us to show the tumor area on the original-colored image, where the last image we have reached represents the mask image, which must be taken like the color image.

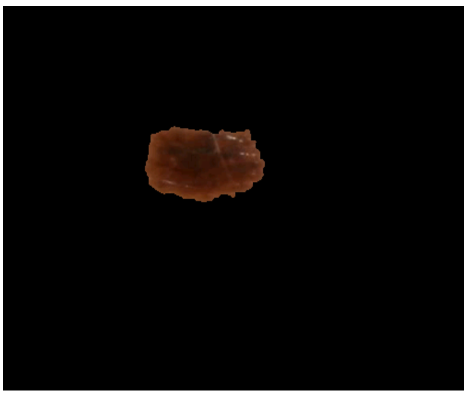

Figure 10: Original colored tumor image

Licensed Under Creative Commons Attribution CC BY

Feature extraction:
The reliance in this research was on the characteristics of color, as according to medical studies and previous studies and according to the nature of the collected images of skin tumors, the following observations were made:

- The skin acquires a dark brown color in a benign or class 1.
- The skin acquires a light brown color with a pinkish color in SCC tumor or class 2.
- The skin acquires a red color in the lesions, which is a tumor of the 3rd class BCC.
- It acquires a smoky blue color in the case of Melanoma class 4.

The mechanism for the feature extraction
The input of this stage is the colored image that includes the tumor area only, and we will calculate the ratios of red, smoky blue, and brown colors in it and we will also calculate the number of pixels in which the ratio of red to green exceeds the specific value, and this percentage represents the probability of red color and it called Red rate. The number of pixels with the blue to red ratio exceeding specific value will be counted and it will be called Blue rate. We will also calculate the number of pixels for Brown rate.

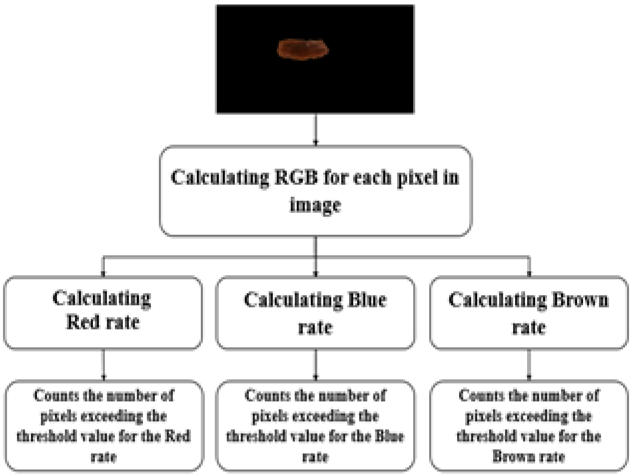

Figure 11: Feature extraction mechanism

Classification stage
It was suggested to use a color classifier based on the color of the tumor area that was extracted in the stage of segmentation of the skin image to know the type of skin tumor.

If the brown rate is higher than the blue rate and the brown rate is higher than the red rate, then we are in the first class, meaning the benign tumor.

As for if the red rate is higher than the blue rate and the red rate is less than the brown rate, then we are in the second class, which is the SCC type.

and if the red rate is higher than the blue rate percentage and the red rate is higher than the brown rate, then we are in Class 3, i.e., BCC.

If the blue rate is higher than the red rate and the blue rate is higher than the brown rate, then we are in the fourth smoke blue class, which is the malignant or melanoma class 4.

Practical results
Matlab was used to implement the proposed design of the system, and Matlab was chosen for several reasons, the most important of which is the ease of dealing with the program compared to other languages.

A graphical interface was designed to simulate the work of all stages of the system.

Performance Evaluation
The system can correctly recognize the test images that were taken during different shooting conditions such as changes in position, background, skin color, and hair covering of the mole, and system allows the user to modify and update the database by adding and deleting images to the database, also the system uses the mole images after they are automatically deducted from the overall image, which gives it the flexibility to be inspected by other systems.

The system uses a simple color coder, which means speed in the performance process.

This system accuracy is 95.12% and the sensitivity is 98.6% while positive prediction is 95.8%.

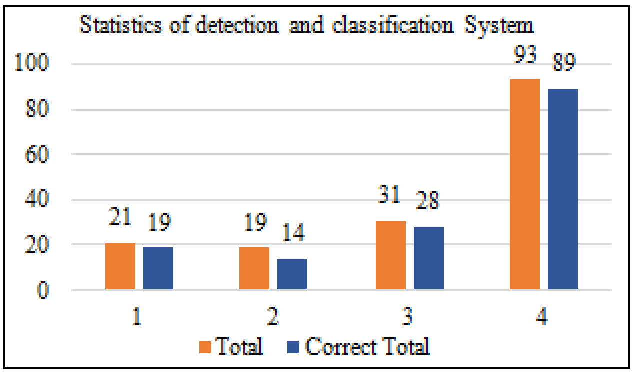

Figure 12: Statistics of detection and classification System

References

[1] http://www.skincancercare.com/skin-cancer-faq.html..[accessed: March.3,2021].
[2] https://www.who.int/news-room/q-a-detail/radiation-ultraviolet-(uv)-radiation-and-skin-cancer.[accessed: March.3,2021].
[3] https://www.wcrf.org/dietandcancer/cancer-trends/skin-cancer-statistics.[accessed: March.3,2021].
[4] Sajjad Rajpar and Jerry Marsden, ABC Of skin cancer, Blackwell, 2008.
[5] Paul K Buxton, ABC Of Dermatology, BMJ books, Fourth Edition, 2003.
[6] https://www.skincancer.org/skin-cancer-information/melanoma/melanoma-warning-signs-and-images..[accessed: March.3,2021].
[7] Suhail M.Odeh ,"Using an adaptive neuro fuzzy inference system (ANFIS) algorithm for automatic diagnosis of skin cancer", European Mediterranean

Licensed Under Creative Commons Attribution CC BY

Middle Eastern Conference on information Systems,PP:1-7, 2010.
[8] Bareqa Salah, Mohammad Alshraideh, Rasha Beidasand Ferial Hayajneh,"Skin Cancer Recognition by Using a Neuro-Fuzzy System", cancer informatics, Volume 10, PP: 1-11, 2011.
[9] Amruta M. Gajbar, Prof. A. S. Deshpande,'' Detection and Analysis of Skin Cancer in Skin Lesions by using Segmentation'', International Journal of Advanced Research in Computer Science and Software Engineering , Volume 5, Issue 4, PP: 1173-1178, 2015.
[10] V. Jeya Ramya, J. Navarajan, R. Prathipa ,L. Ashok Kumar,'' Detection Of Melanoma Skin Cancer Using Digital Camera Images'', ARPN Journal of Engineering and Applied Science, Volume 10, No. 7, PP:3082-3085, 2015.
[11] Omkar ShridharMurumkar, Prof. Gumaste P. P. ,'' Feature Extraction for Skin Cancer Lesion Detection'', International Journal of Science Engineering and Technology Research (IJSETR), Volume 4, Issue 5, PP:1645-1650, 2015.
[12] Siddiq Iqbal, Sophia.M, Divyashree.J.A, Mallikarjun Mundas, Vidya.R,'' Implementation Of Supervised Learning For Melanoma Detection Using Image Processing'', International Journal of Research in Engineering and Technology, Volume 4, Issue 6, PP: 325-329, 2015.
[13] Alwunais, Khalid M., and Sohail Ahmad. "Pattern of skin cancer at Dammam Medical Complex in Dammam, Saudi Arabia." Journal of Dermatology & Dermatologic Surgery, PP:51-54, 2016.
[14] Arati P. Chavan, D. K. Kamat , Dr. P. M. Patil," Classification Of Skin Cancers Using Image Processing ", International Journal of Advance Research in Electronics, Electrical & Computer Science Applications of Engineering & Technology Volume 2, Issue 3, PP: 378-384, 2014 .
[15] Shivangi Jaina, Vandana jagtap,Nitin Pise,'' Computer aided Melanoma skin cancer detection using Image Processing'', Procedia Computer Science ,Volume 48, PP: 735 – 740, 2015 .
[16] Ramandeep Kaur, Gurmeen Kaur,'' Skin Cancer – Melanoma Detection in Skin Images Using Local Binary Pattern (LBP) and GLCM'', International Journal of Science and Research (IJSR), Volume 4, Issue 7, PP: 134-139, 2015.
[17] Reshu Bansal, Meenu Saini,'' A Review of Computer Aided Diagnostic Approaches for Skin Cancer'', International Journal of Advanced Research in Computer Science and Software Engineering, Volume 5, Issue 4, PP: 1278-1282, 2015.
[18] Ammara Masood, Adel Ali Al-Jumaily," Computer Aided Diagnostic Support System for Skin Cancer: A Review of Techniques and Algorithms", International Journal of Biomedical Imaging, Volume 2013, PP:1-22.
[19] Sadeghi Maryam," Towards Prevention and Early Diagnosis Of Skin Cancer: Computer Aided Analysis of Dermoscopy Images", Simon Fraser University,Canada,2012.
[20] Gonzalez R.C.Woods R.E., Digital Image Processing, Prentice Hall,2nd Edition,2004.
[21] John Stoitsis , Ioannis Valavanis, "Computer aided diagnosis based on medical image processing and artificial intelligence methods", Nuclear Instruments and Methods in Physics ResearchA, PP:591–595, 2006.
[22] Vidhyashree G, V Vishvasree, "MELANOMA SKIN CANCER DETECTION USING IMAGE PROCESSING", International Research Journal of Engineering and Technology (IRJET), Volume 7 Issue 7, PP: 2798-2800, 2020.
[23] M.K.Monika, N.ArunVignesh,, Skin cancer detection and classification using machine learning , Materials Today: Proceedings.

Licensed Under Creative Commons Attribution CC BY