Melanoma Detection In Dermoscopic Images Using Ann Classification Algorithm

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Abstract- *Malignant melanoma is the most hazardous type of human skin cancer and its incidence has been hastily increasing. Early stage detection of malignant melanoma is very essential as its detection in the early stage can be helpful to cure it. Computer Aided Diagnosis (CAD) can be helpful in early detection of cancer for dermatologists. In this paper, we represent a novel method for the detection of melanoma using Artificial Neuron Network (ANN) classification. In this ABCD parameters are extracted for the melanoma detection. The method was evaluated on a ISIC dataset of 141 dermoscopic images. CAD could give dermatologists a nearer look at suspicious skin lesions. This can be useful to dermatologists to find suspicious lesions in an early stage. So, intend is to develop computer aided-diagnostic system which is non-invasive technique for the detection of melanoma at early stage.*

Keywords- Melanoma, Dermoscopy, Computer Aided Diagnosis (CAD), ABCD rule, ANN

I. INTRODUCTION

Skin cancer is a major public health concern, with over 5 million newly diagnosed cases in the United States each year [1]. Melanoma is one of the most lethal forms of skin cancer, previously responsible for over 9,000 deaths a year in the United States alone [2], and over 10,000 estimated deaths in 2016 [3]. As melanoma occurs on the skin surface, it is amenable to detection by simple visual examination. Indeed, most melanomas are first seen by patients, not physicians [4]. However, unaided visual inspection by expert dermatologists is associated with a diagnostic accuracy of about 60%, meaning many potential curable melanomas are not detected until more advanced stages [5]. To improve diagnostic performance and reduce melanoma deaths, dermoscopic has been introduced, which is an imaging technique that eliminates the surface reflection of skin, allowing deeper layers to be visually enhanced. Previously most groups have proposed computer aided diagnosis systems to identify melanomas in dermoscopic images. These systems use several features, such as color, shape, and texture, to characterize the images. These features are given in medical algorithms such as the ABCD rule[6].

The remaining paper is organized as follows. In Section II we describe causes and signs of melanoma. In Section III, literature review is presented. In Section IV, we describe the methodology used and in Section V, explains implementation of proposed methodology and VI represents result and section VII gives some conclusion.

II. CAUSES AND SIGNS OF MELANOMA

2.1 Causes:

Sun exposure, within the shape of UVB and UVA light, is a capacity motive of cancer. Evidence suggests that several episodes of sunburn because of extreme, intermittent sun publicity notably growth the hazard of growing a melanoma later in existence [7]. There is rising evidence that publicity to ultraviolet radiation thru the use of sun beds additionally increases the danger of melanoma. In 2009, the International Agency for Research on Cancer raised the type of ultraviolet-emitting tanning gadgets to carcinogenic to humans‖ inside the highest-danger category . This is based on proof that folks who frequently use solar beds have a significantly better chance of growing coetaneous cancer. The maximum recent meta-analysis concluded that the use of solar beds will increase the risk of melanoma with the aid of 75%, specifically while used before the age of 35 [8]. Ultraviolet radiation appears to induce melanoma through many mechanisms, which includes suppression of the immune system of the pores and skin, induction of melanocyte cell division and loose radical production. Free radicals are extremely reactive molecules that are produced in the frame evidently as a byproduct of metabolism, and due to exposure to pollutants in the surroundings such as tobacco smoke and ultraviolet light. Free radicals comprise an unpaired electron. In essence, they're in a consistent seek to bind with some other electron to stabilize themselves – a procedure that may harm DNA and different parts of human cells. This damage may also take part in a function in the improvement of cancer and different diseases, in addition to accelerating the getting old method [9].

2.2 Signs:

i. Change in size – the mole may additionally emerge as lumpy or spread outwards over the pores and skin.
ii. Change in shape – maximum moles have a clean, regular define, but a melanoma is much more likely to have an abnormal, ragged edge.
iii. Change in color – the mole may additionally expand a reddish edge. It can also come to be darker or seem to have extraordinary sun shades of color, usually a mixture of brown and black.
iv. Iv. Melanomas also can be pink, due to infection, or have a blue-white tinge due to partial clearing inside the centre.
v. Diameter – most regular moles are smaller than the blunt quit of a pencil (7mm).
vi. Inflammation – many early melanomas are inflamed or have a reddish edge.
vii. Crusting or bleeding – mild oozing is a common symptom and causes the melanoma to stick to apparel sensory change – itching.

III. LITERATURE SURVEY

Celebi et al. Summarized all the studies in this subject within the beyond 30 years and furnished destiny guidance for clinical image evaluation. Most research on this vein revolves round evaluation of pores and skin lesion pictures taken the use of dermatoscope (dermoscopic photos) and falls under three exclusive categories: mathematical modeling primarily based on positive functions of the lesion, fuzzy-common sense primarily based systems, and neural network primarily based systems [10].

Ercal et al. Defined a simple neural community classifier that extracts the asymmetry, border irregularity and shade features of an photo and fed them to a feed forward neural community. However, because of the restrained wide variety of functions extracted, the machine should simplest reap among 70-80% category accuracy [11].

Gniadecka, et al. Proposed a technique that used Raman spectroscopy and neural networks for detecting pores and skin cancers. They focused a laser beam at the skin lesion to excite the molecules within the lesion. The scattering effect of the molecules within the pores and skin lesion causes frequency shifts inside the meditated Raman spectra. They trained a neural community with the contemplated beam's frequency traits, and were able to get appropriate sensitivities. However, Raman spectrometers aren't widely to be had and are very pricey, and hence are rarely utilized by dermatologists. Although a lot work has been done within the discipline of neural network primarily based type of dermoscopic images, there's but to be a classifier that is accurate, realistic, and wellknown sufficient to have a actual-global impact [12].

Jaleel and Saleem , defined a neural community based classifier that did no longer use any of the ABCD functions but relied on functions extracted from the two-D wavelet transformation of the pix. The pattern size used in their category become small (much less than 21 pics) and there was no point out of the performance or sensitivity carried out by way of the device. Smaller training and testing pattern sizes commonly cause over-fitting, in which the learning gadget tends to alter to particular random quirks of the education information that can not be generalized to larger samples [13].

Stanley et al. Proposed a fuzzy common sense based shade histogram evaluation method for pores and skin lesion determination. However, sizable coloration adjustments in melanoma skin lesions arise most effective in superior tiers. Depending absolutely on the coloration histogram alone will now not assist in early detection [6]. Fuzzy class techniques additionally have the tendency to over-in shape because of the absence of gaining knowledge of. Since fuzzy logic makes use of more advanced techniques to come across lesions, it's miles in reality most desirable to a simple formulation. However, in contrast to a machine learning based totally device, the accuracy of the device does not enhance after the initial device parameters are chosen [14].

Stoeker et al. Proposed an automated classifier that quantified sure features of the lesions and applied it to a formula. If the result of the formula is above a sure threshold, the lesion changed into categorised as malignant. Otherwise, the lesion become classified as benign. Although this formulaic technique become able to reap a sensitivity of above 80%, this device had no way of mastering from enjoy with new lesions and for this reason is inferior to even a trendy visible inspection [15].

Fatima.R. Et al. Introduces a multi-parameter extraction and classification gadget to useful resource an early detection pores and skin most cancers cancer[16].

Fasihi, N. Describes usage of morphologic operators for segmenting a photo and wavelet evaluation to extract the feature which leads to to better cancer analysis device [17].

Alcon, J.F. Has used pigmented pores and skin lesion pics, captured the use of digital digicam for computerized melanoma diagnosis with an accuracy of eighty five%, sensitivity of ninety three% and specificity of sixty nine%[18].

Patwardhan Jain, Y. K. Focuses on the improvement a skin most cancers screening system that can be utilized by non-experts to categorise regular from bizarre instances, using characteristic calculation and classification techniques. Here capabilities are extracted the use of wavelet remodel wherein because the class is completed the usage of synthetic neural networks [19].

S. V. Dhawan et al uses wavelet transformation based skin lesion images type device which makes use of a semantic illustration of spatial frequency data carries in the pores and skin lesion pics .[20].

M. Celebi et al. The authors have used the method of dividing the enter picture into various clinically great regions the use of the Euclidean distance transform for the extraction of color and texture functions [21].

According to the above literature, image processing is an crucial diagnostic parameter for cancer. Some literature outline importance of machine mastering algorithms in cancer detection. Most of the techniques are sturdy, dependable, computer-aided diagnostic tool for analyzing the texture in lesions of the pores and skin. Different literature applied extraordinary methods used for extraction of feature set as well as final class in terms of cancerous or non cancerous image.

IV. METHODOLOGY

The technique used for Melanoma Skin Cancer Detection the use of Image Processing is as shown in Fig. 1. The input is the image of the skin lesion from ISIC 2016 dataset. MATLAB 2016a Software is used for test. Different images processing techniques and Artificial Neuron Network is used for implementation. The input skin lesion-image is then pre-processed to enhance the image nice. The binary mask is used for image segmentation. The RGB coloration space is used. The segmented image is given to the feature extraction block which includes skin-lesion analysis for its geometrical functions and ABCD features. The extracted capabilities are similarly given to the class stage which classifies skin lesion as cancerous or normal through the use of Artificial Neuron Network.

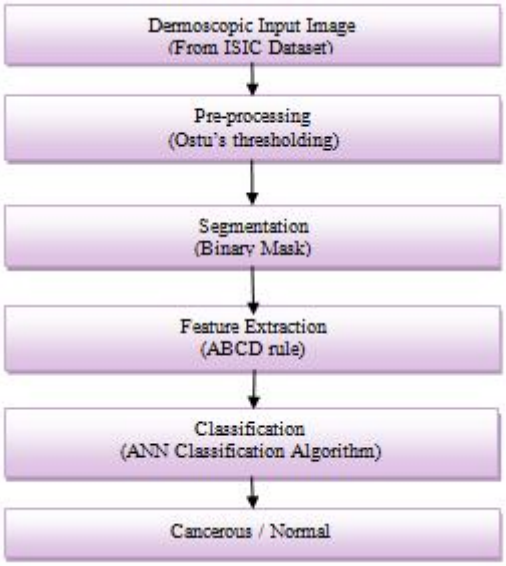


Fig.1Methodology

The ABCD rule of dermoscopy was the first method of the melanoma used in dermoscopy. This model was described by Stolz and colleagues in 1994. For the calculation of ABCD score the criteria of asymmetry (A), abrupt cut-off of the pigment sample at the border (B), colors(C), and distinctive structural additives such as diameter (D) are assessed to yield a semi-quantitative rating. The ABCD rule has been proved to be beneficial in:

1. Early detection of malignant melanoma.
2. Discrimination between benign and malignant lesions.
3. Selection of lesions for excision in patients with numerous typically appearing nevi.
4. Monitoring of certain malignant nevi that for cosmetic or patient preference were not removed.

V. IMPLEMENTATION OF PROPOSED METHODOLOGY

Depending upon the implementation of the ABCD rule specific degrees of accuracy can be predicted, for instance there exists a variety of algorithms with the intention to find the axis of symmetry of pix with distinctive relative precision and robustness. The equal applies to Border/Edge detection schemes and to dedication of abruptness of pigment exchange at the border of a lesion. Color and Diameter parameters may be calculated with much less uncertainty. Our first approach is to apply the only algorithms to be had that nonetheless produce fairly correct consequences when in comparison to human visual evaluation. The steps that had been programmed are the ones concerning the pre-processing of the picture (steps 1-5), with the primary calculations following (steps 6-10):

1. Input of the image in RGB color format.
2. Transformation of the photograph in Gray level format.
3. Image histogram equalization to increase assessment.
4. Converting photo into black & white binary format the use of a set manually brought threshold.
5. Edge & inner pattern detection the use of Prewitt technique with fixed manually introduced threshold.
6. Lesion bisection into (orthogonal) axes–axes willpower by using moment's method, main components evaluation, gradient & orientation histogram, and so forth. Or a few very simple sampling method.
7. Asymmetry rankings a calculation via picture overlapping.
8. Division of lesion in eight segments and resolution of pigment change in each segment for calculating the B rating (0-8 factors).
9. Determination of presence of 6 fundamental colors inside the lesion (white, purple, light brown, dark brown, blue-gray, black) giving 1 point to every for the calculation of the C score.
10. Calculation of the lesion diameter primarily based upon the edge of the lesion observed on step 5, and determination of the D rating hence.
11. Then we should teach and take a look at dataset the usage of ANN class set of rules.

Especially steps 6 & eight can be implemented the usage of from very state-of-the-art up to very simple algorithms and this is expected to significantly have an effect on the future improvement attempt. More mainly, at this point the focus is on step nine willpower of presence of 6 basic colors in the lesion (white, crimson, mild brown, darkish brown, blue-gray, black) giving 1 point to every for the calculation of the C score. Step 11 is critical to teach and test dataset to calculate sensitivity(SE), Specificity(SP) and Accuracy for carried out device.

VI. RESULT

In this paintings, we have applied ABCD rule and feature made simplified study on skin most cancers. We chose ABCD rule because it is quite simple and rapid set of rules, beneficial for the effective and automatic detection of melanoma. We i laptop aided analysis of melanoma in MATLAB 2016 implemented. By applying photo processing techniques, then received results have proven the ability to categorise cancerous and non-cancerous lesions using Machine learning set of rules ANN. This computer aided detection has proven to be short, spontaneous and cost powerful. The purpose of the mission is to help studies and development of algorithms for computerized prognosis of cancer, a lethal form of skin most cancers, from dermoscopic photographs. 141 pix of cancer are taken from ISIC 2016 database . The International Skin Imaging Collaboration (ISIC) is an worldwide attempt to enhance melanoma analysis, which has currently began efforts to mixture a publicly accessible dataset of dermoscopic pics.

Step-1: Input Image From ISIC Database:

Select input image from ISIC dataset for detection of Melanoma.

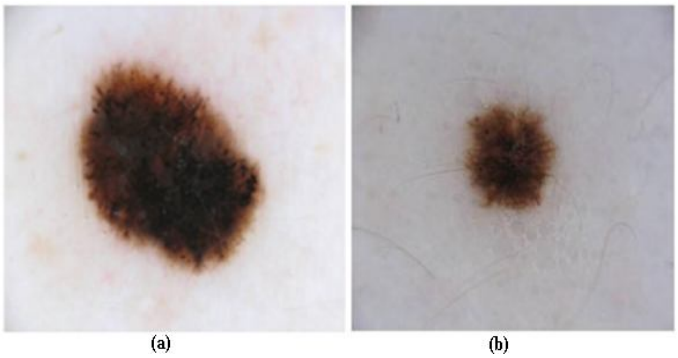


Fig.2: Original image: (a) Original image of true positive (melanoma)
(b) Original image of true (mole) negative

Step-2: Creating Binary Mask: We implement two methods for creating binary mask:

The input image is then preprocessed using Ostu's method. First resizing of input image to (256 X 256) size. Then implement inbuilt command imfilter with the multidimensional filter of 25 X 35 size to adjust intensity of image. Then convert image into grayscale. Then using Otsu's thresholding method convert grayscale image into binary image the Otsu's method, which chooses the threshold to minimize interclass variance of the black and white pixels.

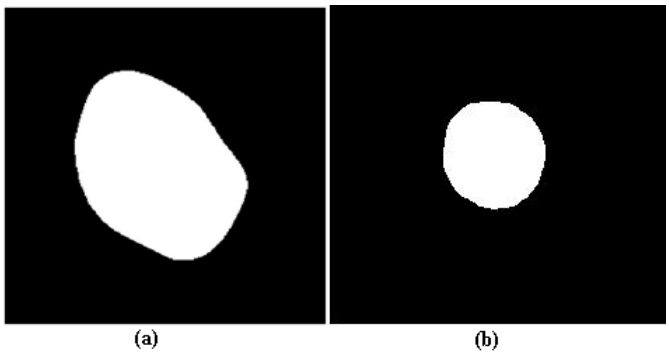
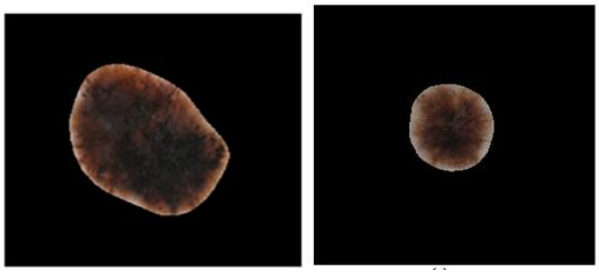


Fig.3: (a) Binary mask of true positive sample (melanoma) using RGB
(b) Binary mask of true negative sample (mole) using RGB

Step-3: Segmentation of lesion from original image using binary mask:

Then apply binary mask on preprocessed image.

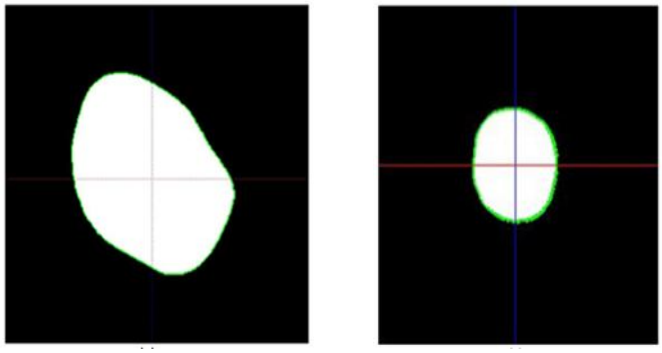


(a) (b)

Fig.4: (a) Lesion segmentation from true positive (melanoma)
(b) Lesion segmentation from true negative (mole)

Step-4: Calculation of geometric center of segmented lesion:

Then calculate geometric centre for segmented lesion for next step i.e. for feature extraction.



(a) (b)

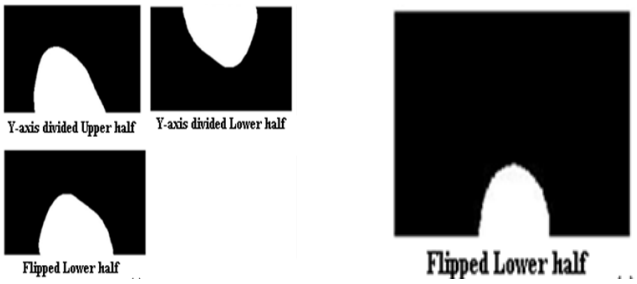
Fig.5: (a) geometric center of segmented lesion(Melanoma)
(b) Geometric center of segmented lesion(Mole)

Step-5: Images feature extraction:

This step aims to extract characteristics of the resulting images segmentation through algorithms that allow extracting the information precisely. These algorithms must be represented by a data structure suitable for recognition of these features extraction. It is important to note that in this step the input is still an image, but the output is a set of data corresponding to the image. After the segmentation four parameters were extracted which belongs to the ABCD rule, they are: asymmetry, border, color and lesion diameter. These parameters were calculated for dermoscopic images of skin lesions.

1. Asymmetry Parameter:

Asymmetry: asymmetry of the calculation was based on the method proposed by Stolz in 1994, where the image of the lesion is divided into two segments perpendicular to each other (horizontal and vertical) and, positioned on the lesion to produce the lowest score of asymmetry.



(a) (b)

Fig.6: (a) Y axis divided of binary image for melanoma
(b) Y axis divided of binary image for mole

The calculation of asymmetry gives an analysis of the lesion at a geometry level. So it was proposed an area test for analysis of the lesions, where the amount of black pixels (which corresponds to the region of the lesion) belonging to each axis (on both the positive and the negative), are counted. Then the difference in the amount of pixels on both sides is calculated. A variation of ± 0.25% is considered in the difference between the correspondent pixels, since in the segmentation process, there is a possibility to count false pixels in the border. If both axes are asymmetrical, its score is 2. If the asymmetry is in only one of the axes its score is 1, and if there is no asymmetry its score is 0. Most melanomas have a score of 2, as opposed to benign nevi and melanocytes nevi.

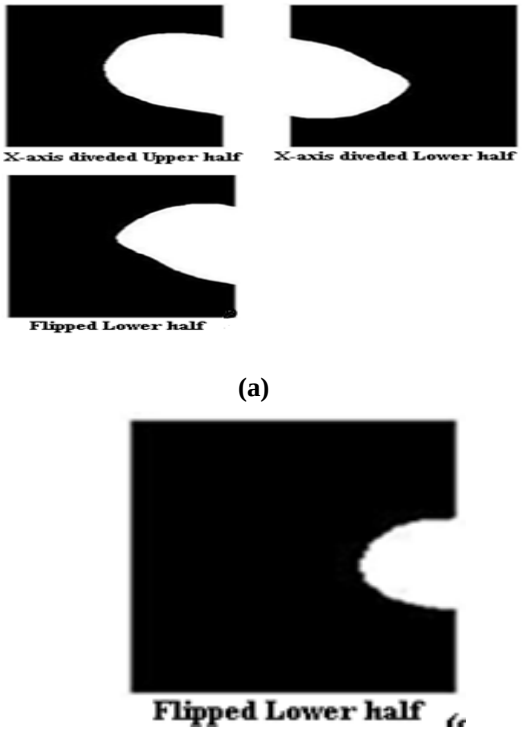
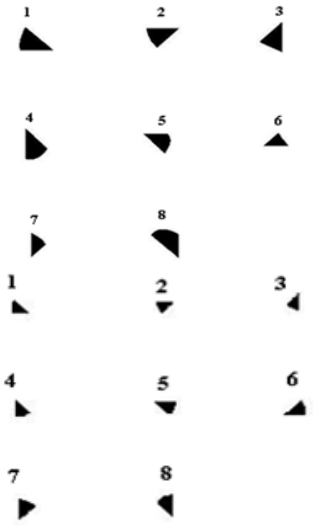


Fig.7: (a) X axis divided of binary image for melanoma
(b) X axis divided of binary image for mole

2. Border:

The lesion is divided into eight equal parts, as shown in Figure 8(a)(b). The score is found by the analysis of eight parts, i.e., the amount of black pixels belonging to each slice is counted and this amount was compared to amount obtained in other slices. A variation of ±20% was considered. For each slice presenting a difference greater than the established here 1 point is summed to the total score.



(a) (b)

Fig.8: (a) Lesion is divided into eight equal parts of binary image for Melanoma
(b) Lesion is divided into eight equal parts of binary image for Mole

3. Color:

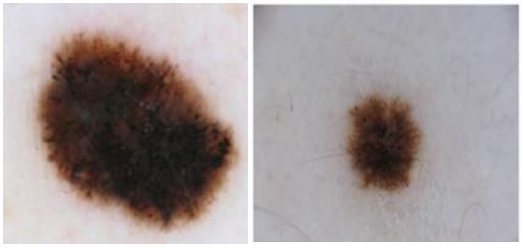
In the ABCD rule the observed colors indicating malignancy are black, white, blue-gray, light brown, dark brown and red. A range of possible colors for each of these six tones was used as a matter of evaluation in this test, as presented in table1. The colors observed were only counted if it occupies an area of 0.1% of the total lesion area, since the variation is estimated as tolerance factor for each channel R, G and B. This variation was ± 10 color levels for each channel. The presences of each shade of gray add more value in a score where the minimum is 1 and the maximum is 6.

Table1 : RGB description of ABCD colors

Sr. Issue	Color	RGB	Rgb
01	White	255,255,255	1.0,1.0,1.0
02	Black	0,0,0	0.0,0.0,0.0
03	Red	255,0,0	1.0,0.0,0.0
04	Light-Brown	205,133,63	0.80,0.52,0.25
05	Dark-Brown	101,67,33	0.40,0.26,0.13
06	Blue-Gray	0,134,139	0.0,0.52,0.54

4. Diameter:

Values above 6 mm are alarms of malignancy, and the score is based on this length. To obtain this parameter, the amount of pixels in the width and height of the lesion were determined, therefore obtaining the average amount which is converted in millimeters. For each 1mm step 1 point is added to the score of the diameter.



(a) (b)

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Figure 9: (a) The result using ANN for true positive (melanoma) sample using RGB
(b) The result using ANN for true negative sample (mole) sample using RGB

Evaluation Metrics:

To quantitatively compare the borders drawn by dermatologists with the computer derived borders, different metrics have been utilized. The three statistical measurements of sensitivity, specificity and accuracy are applied.

Sensitivity = TP/ (TP + FN)
Specificity = TN/ (TN + FP)
Accuracy = (TP + TN)/ (TP + FP + FN + TN)
Where
TP = true positive,
TN = true negative,
FP = false positive, and
FN = false negative, respectively.

Table2: Classification Result Using ANN

Sr. No.	Parameter	ANN
01	Sensitivity(SE)	88.63%
02	Specificity(SP)	93.50%
03	Accuracy	91.73%

Fig.10: Confusion matrix for neural network

So, we got 91.73% accuracy using ANN classification algorithm.

VII. CONCLUSION

It has been demonstrated in this study that MATLAB 2016a is a powerful tool for the early prediction and diagnosis of malignant melanoma by using image processing techniques and machine algorithms. Only a few lines of compactly written code are enough in order to program the required algorithms. We have implemented ABCD rule & choose ABCD rule because, it is very simple and efficient algorithm, functional for automatic detection of melanoma. We have developed a code for ABCD rule in MATLAB 2016a. Within of the DIP area, the work goal was covered and achieved namely: the pre-processing, the segmentation and the feature extraction (asymmetry, border, color and diameter) from skin lesions dermoscopic images. The results obtained have demonstrated the ability to classify cancerous and non-cancerous lesions. This computer aided detection has proven to be quick, spontaneous and cost effective.

In this paper, we implemented ANN algorithm for classification of mole as cancerous or normal. The result obtained using a ISIC 2016 dataset. The performance of the system gives Sensitivity (SE) = 88.63% and Specificity (SP) = 93.50% and Accuracy 91.73%. Color features derived from other color space RGB.

VIII. ACKNOWLEGEDEMENT

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