Comparative Evaluation of Abnormality Detection Techniques in Dermoscopic Image

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Abstract - Skin cancer is the most common form of cancers among humans. It accounts for almost 60-70% of all human carcinomas. According to literature, the melanoma is mainly caused by Ultra Violet (UV) radiations. Early detection of melanoma is very important which leads to higher chances of survival with early treatment. Digital image processing plays a vital role for early detection of melanoma. Various image processing techniques are there which are used to diagnose whether it is the case of melanoma or not.

I. INTRODUCTION

Skin cancer is precarious form of cancers among human beings. There are different types of carcinomas like melanoma and non-melanoma basal and squamous. Among all these kinds, melanoma is the foremost cause of deaths in India. Melanoma is mainly caused by Ultraviolet Radiations. UV radiations cause skin tan which is caused by ozone layer depletion due to pollution. Early detection of melanoma is very important otherwise it may prove fatal. Techniques used by dermatologists are not sufficientto diagnose melanoma at early stage. Digital Image Processing along with Dermoscopic techniques are proved very useful in early detection of melanoma. Dermoscopic image that are known as in-situ images, are used for this purpose. These images are taken through high resolution cameras. These techniques are used to differentiate between benign and malign melanoma and covers various features like area, diameter, and symmetry of the tumour, blue-whitish veil, and presence of multiple colors. This collaboration of dermatologist's experience and image processing algorithms will result into highly accurate computer system to detect melanoma at early stage [1].

II. RELATED WORK

It is clear that early detection of melanoma is very much important, so various computational techniques have been proposed which are ABCDE technique, 3 point checklist, Modified ABCD. The very first system which was published by Pehambergeret. al. in 1987 and this system was named as 'Pattern Analysis'. This was the most popular technique at that time. But the major disadvantage was that this system required vast experience on the skin cancer images i.e. the presence of a dermatologist was must. Taking into mind the need of an independent computer system, various approaches are published and these all compete with each other in the field of accuracy i.e. the best system should be most accurate and independent. Various medical techniques are combined with image processing techniques till now which are explained below:

A. NishaOommachenet. al.(2013)

It is very common system. Malignant melanoma is detected by calculating a value which is termed as TDS value. By evaluating this value , decision is made.[2] This is given as:

TDS= A*1.3+B*0.1+C*0.5+D*0.5
A-Asymmetry
B- Border
C-Color
D-Dermoscopic Structures

B. Md. AmranHossenBhuiyan (2013)

ABCDE: ABCDE stands for Asymmetry, Border, Color, Dermoscopic structures and Evaluation. It is based on TDS scoring method discussed above. E stands for evaluation which means the increase in the degree of malignancy with time, the change in the form of the tumor with time elapse. Diameter is included in this test which states that if diameter is greater than 6mm, then it is the case of malignant melanoma. Out of these five parameters, if positive result occur for any one of the feature, then tumor is declared as melanoma.

C. Aurora Saez et.al(2014)

PATTERN ANALYSIS - Pattern analysis basically involves two types. One is Local pattern and other is Global pattern. Global features represent the parameters which are more commonly found in skin cancers. They do not need more diagnosis. Other type consists of global features which include the parameters which are present only in limited group of melanomas. In case of global patterns, the features which were extracted for melanoma are multi-component patterns and for benign were globular and homogeneous patterns. In case of Local patterns, atypical pigments, regression patterns, irregular streaming, irregular blue and brown dots, and multicolored pattern were detected. On the other hand regular blue and brown dots, regular streaming and two colored patterns were associated with benign cases. Some features of benign cases were further found the melanocytic features. Also Pattern Analysis requires the expert doctors to get accurate results.

D. Fabbrocini et.al (2013)

7 POINT CHECKLIST In the earlier techniques some technical features like edge steepness of image contours were detected which were not easy to be understood by

doctors. So a simple technique was proposed that can be easily understand by doctors and which involved only seven features. This technique is named as 7 point checklist method. It is a scoring method i.e. on the basis of scores given to the features involved.

E. G.Zouridakiset. al.

An automated image segmentation and classification system has been developed to detect whether melanoma is malign or not. It involves three basic steps:

1. Segmentation of images of melanoma using various edge detectors discussed earlier.
2. Then select the segmented image which approaches to accuracy based on the scoring method.
3. After that classification of images as melanoma or benign cancer. Various classifiers are used like artificial neural network classifier.

III. PROPOSED RESEARCH WORK

This project covers five techniques which include total eight features. These features are area, diameter, symmetry, perimeter, radial streaming, multiple colors, multiple blue and brown dots and broadened network. Combinations of these parameters will result in five major techniques. All there parameters are calculated by using various image processing algorithms. In each technique, presence of any single feature will indicate the Malignant Melanoma. Threshold is decided for each parameter. On application of derived algorithms, if any parameter has value greater than this threshold then it will be diagnosed as Melanoma. Once Melanoma is detected, its treatment is possible. After detecting all the parameters included in five techniques, the success rate of the techniques are compared. All these techniques are shown in Table 1 as below

TABLE1: VARIOUS TECHNIQUES FOR MELANOMA DETECTION

TECHNIQUES	FEATURES
A	Perimeter, Presence of Single Color and Number of Pigments
B	Multiple Blue Dots , Border and Area of tumour
C	Asymmetry, Multiple Brown dots and border
D	Network pigments, Area, Diameter and Presence of Single Color
E	Diameter, Asymmetry and Irregular Streaks

A. TECHNIQUE A

The parameters involved in this technique are Perimeter of the tumour, Presence of single color and Number of pigments.

1. **Perimeter-** In order to detect the perimeter of the tumour, input RGB image is first converted into binary image. All the derived algorithms work on binary images. Next step is to detect the boundaries in the image. Using connectivity criteria perimeter is found out by calculating the distance between boundary pixels and adding those distances.[4]
2. **Presence of single color-**The melanoma is confused with the moles present on body. But the mole is of single color either black or brown. So, if more than one color is present, then this signifies the melanoma. In order to find the number of colors present in tumour's image, K-Means Clustering Algorithm is applied on the in-situ images. This algorithm works on the principle of Euclidean Distance and finds out the number of colors present in the image. 'N' is defined as the number of clusters.
3. **Number of Pigments-**Firstly, the RGB image is converted into Grayscale image. This algorithm works on the basis of connectivity. Connectivity is of two types. It may be 4-connectivity or 8-connectivity. By generating any one of the connectivity, number of connected pixels is calculated. Threshold for counted pixels is selected and on the basis of this threshold, decision is made that whether melanoma is benign or malign. These steps are shown in figure 1 and 2 below.

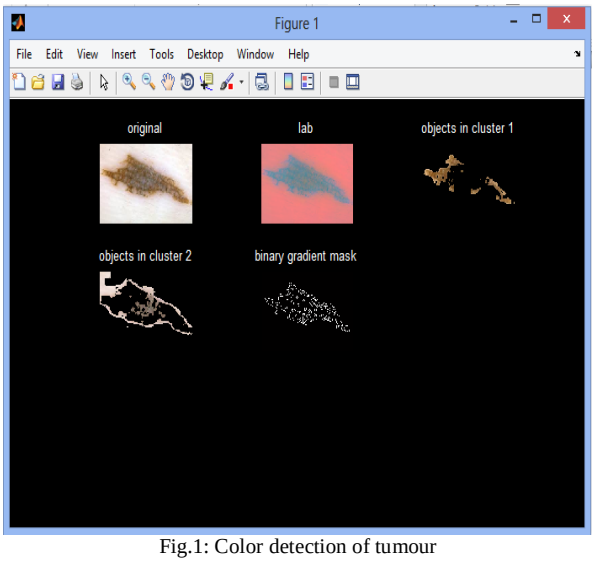

Fig.1: Color detection of tumour

```
cc =

    Connectivity: 4
       ImageSize: [183 275]
      NumObjects: 647
    PixelIdxList: {1x647 cell}

perimeter = 798.4234
>>
```

Fig. 2: Detection of perimeter

B. TECHNIQUE B

Multiple blue dots, Border and Area are the parameters which are covered in this technique. Following are the algorithms to detect there features:

1. **Multiple Blue Dots-** RGB image is first converted into binary image. Segmentation of the image is done and cleared border is generated which is the final image. The black dots which are present in the cleared border image represents the blue dots [7] as shown in Fig 3 and 4.
2. **Border-** border detection is very important part of the whole process. Initialisation of the border pixel is the very first step. Then after getting the initial pixel, the border is traced as shown in Fig 5.
3. **Area-** Area of the melanoma part is find out by calculating the total pixels covering that part and then summing the area covered by pixels.[5] as shown in Fig 6.

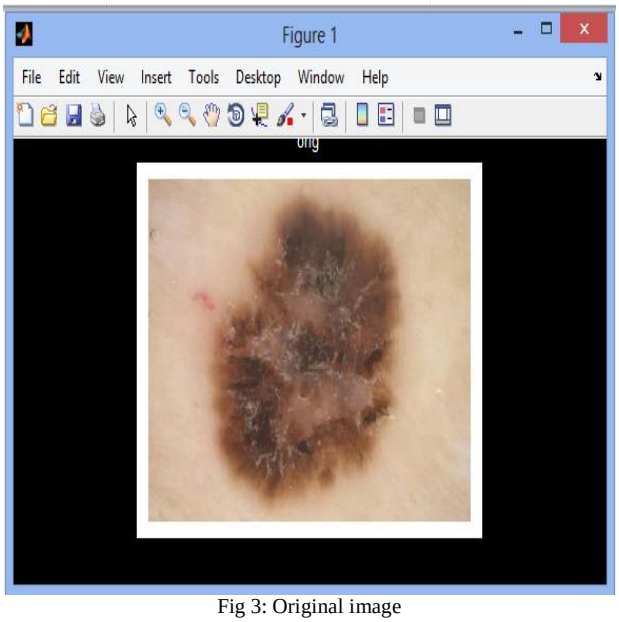

Fig 3: Original image

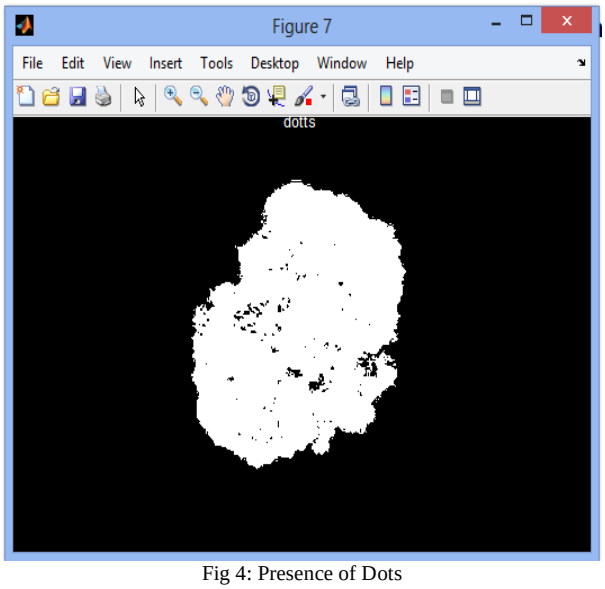

Fig 4: Presence of Dots

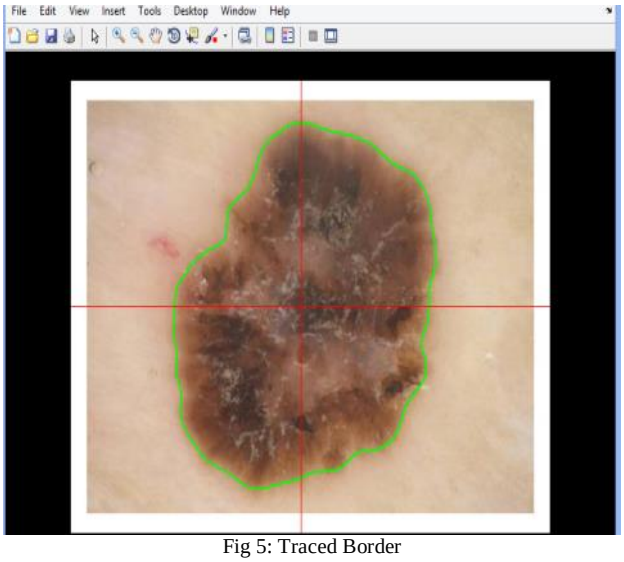

Fig 5: Traced Border

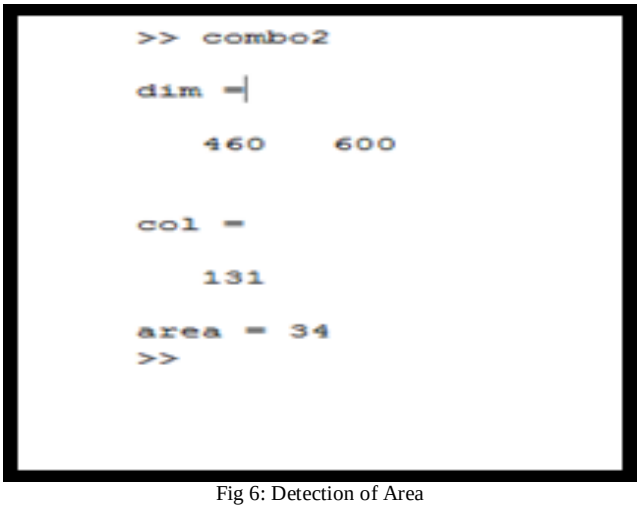

Fig 6: Detection of Area

C. TECHNIQUE C

This techniques involves asymmetry, Multiple Brown Dots and Border Detection.

1. **Asymmetry:** It is very important to find out whether the infected part is symmetrical around the major axis or not. Here two halves of the tumour are separated and they are overlapped to check the symmetry. The results are shown in Fig 7.
2. **Multiple Brown Dots-** RGB image is first converted to binary and segmentation of the image signifies the presence of dots as described in Fig 9 which shows the absence of Brown dots.
3. **Border-** Border of the image is detected by converting the image to grayscale and by tracing the border of the image.[7]

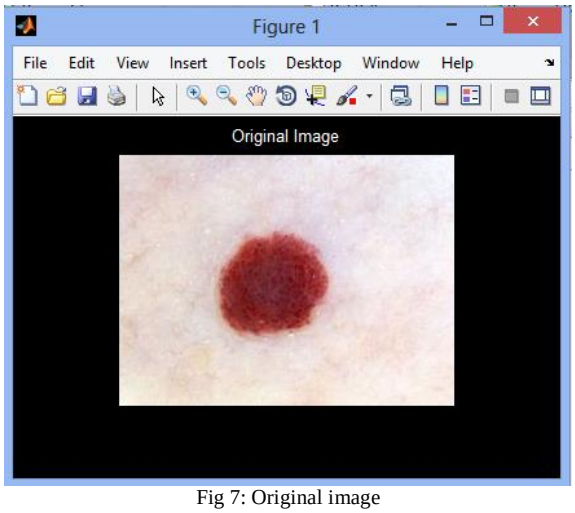

Fig 7: Original image

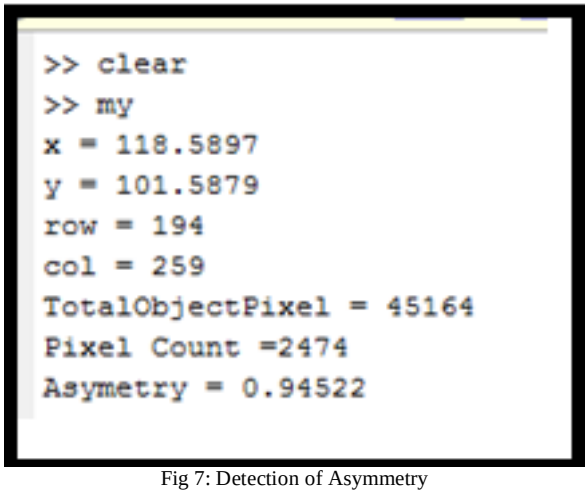

Fig 7: Detection of Asymmetry

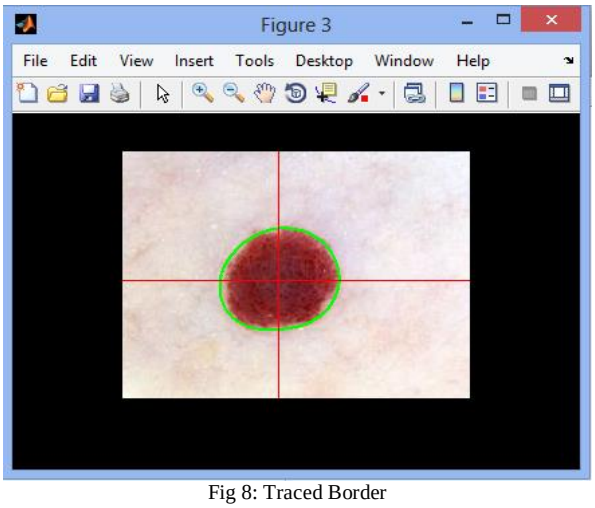

Fig 8: Traced Border

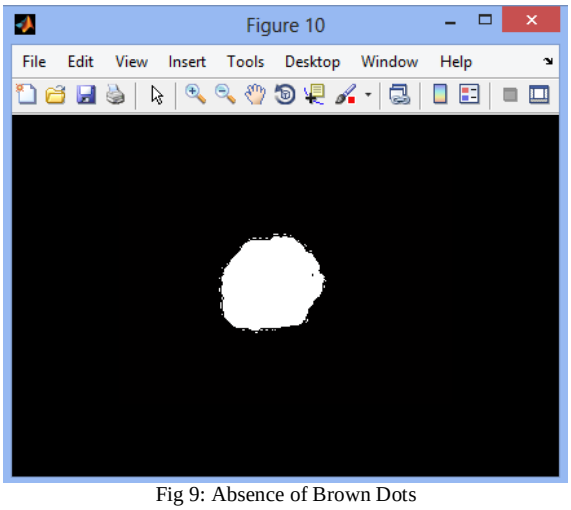

Fig 9: Absence of Brown Dots

D. TECHNIQUE D

Presence of Network pigments, Area, Diameter of the image and presence of single color are the main features of this technique which are shown below. The results for this techniques are shown in Fig 10, 11 and 12.

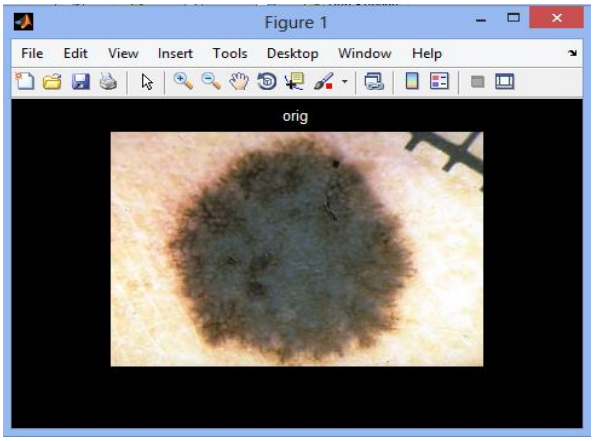

Fig 10: Original image

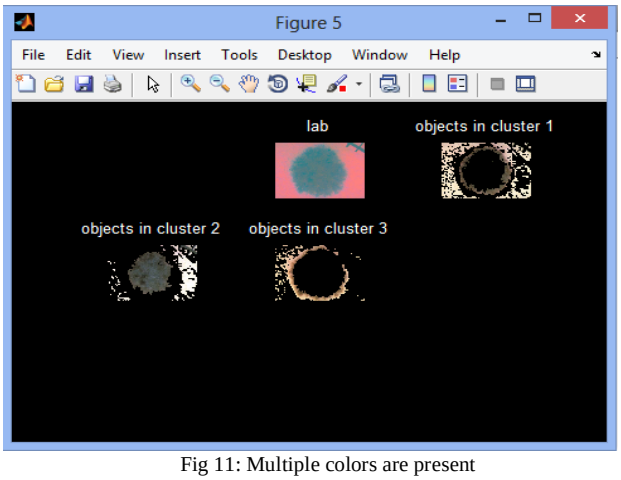

Fig 11: Multiple colors are present

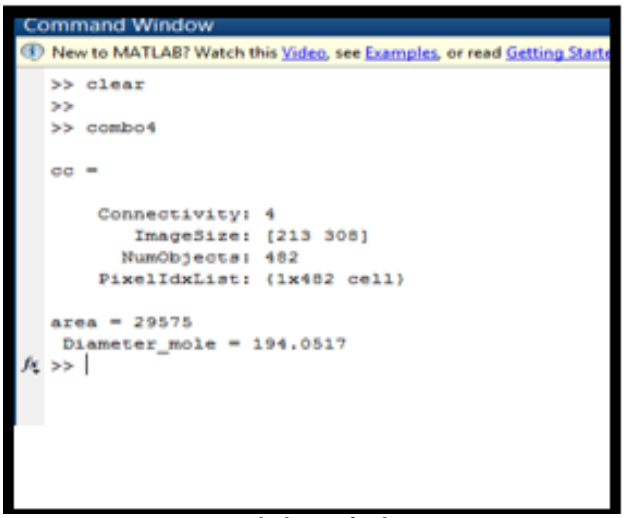

Fig 12: calculations for diameter

E. TECHNIQUE E

Major parameters are Diameter, Irregular streaks and asymmetry.

Irregular Streaks- The RGB image is first converted into binary image and SOBEL edge detector operator is applied on the image and three different thresholds are selected in segmentation step.Using these three different value draw contour diagrams of three images and select the image has best contour and subdivide that image into 8 parts and calculate the ration 'R' which is given as:

R= Number of contour pixels in the region/ Number of shortest path pixel.

A threshold value for this ration R is selected which differentiates between malign and benign Melanoma.[3],[8]. Fig 13, 14, 15 signifies the whole technique.

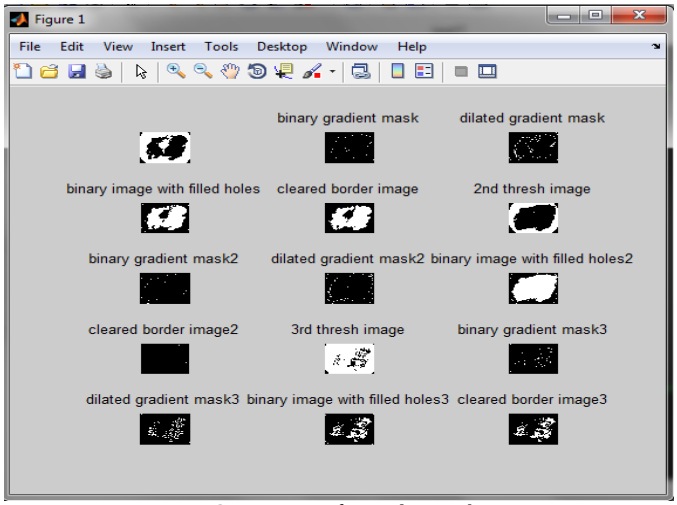

Fig 13: Detection of irregular streaks

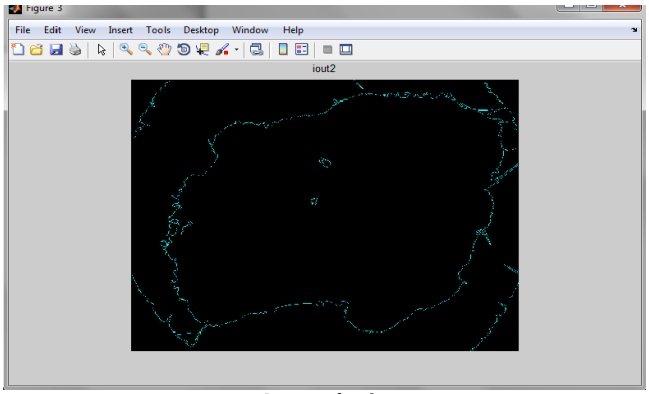

Fig 14: Contour for the tumour

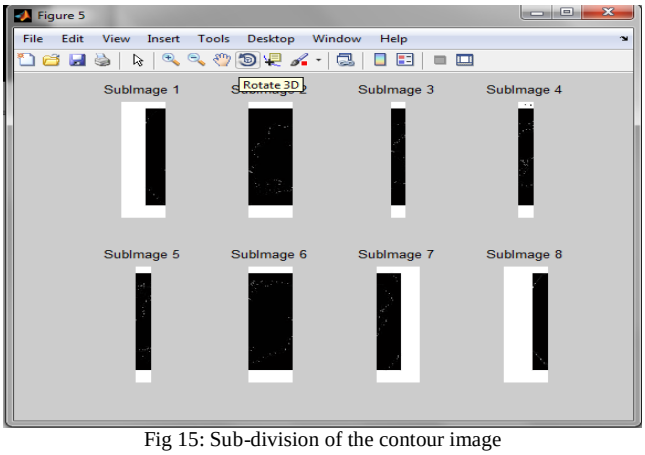

Fig 15: Sub-division of the contour image

IV. RESULTS AND DISCUSSION

The threshold values for the parameters mentioned in the above techniques are tabulated as below:

TABLE 2: RESULTS OF FIVE TECHNIQUES

TECHNIQUES	FEATURES	RESULTS
A	Perimeter	Threshold>500
	Presence of single color	Different colors present in predefined clusters
	Number of connected pixels	>350
B	Multiple blue dots	Presence of black dots in inverted binary segmented image
	Border	Irregular border
	Area	>500
C	Asymmetry	>0.70
	Brown Dots	Presence of dots in inverted and segmented binary image
	Border	Uneven Border
D	Presence of Network Pigments	Number of boundary pixels>400
	Perimeter	>10,000
E	Diameter	>100
	Asymmetry	>0.70
	Irregular Streaks	>75

SUCCESS RATE COMPARISION OF TECHNIQUES

TECHNIQUES	SUCCESS RATE
A	80%
B	70%
C	75%
D	90%
E	75%

V. REFERENCES

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