ASYMMETRY ANALYSIS FOR DIAGNOSIS OF MALIGNANT MELANOMA

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***Abstract*- Malignant melanoma which is known as Skin cancer is the uncontrolled growth of abnormal skin cells. It occurs when unrepaired DNA damages to skin cells triggers mutations or genetic defects that lead the skin cells to multiply rapidly and form malignant tumours. Incidence of skin cancers has been increasing since the last few decades worldwide. Early detection of skin cancer has the potential to reduce mortality and morbidity. Image processing techniques used for skin cancer detection are based on the well known ABCD analysis. This paper proposes a method which helps in finding asymmetry of the images. In this paper different digital images are tested using MATLAB R2013a.Results obtained shows the feasibility of the proposed method for skin cancer diagnosis.**

***Index Terms*- Skin Cancer, ABCD rule, asymmetry analysis, diagnosis.**

I. INTRODUCTION

Skin cancers are cancers that arise from the skin. They are due to the development of abnormal cells that have the ability to invade or spread to other parts of the body. There are three main types: basal cell cancer (BCC), squamous cell cancer (SCC) and melanoma. The first two together along with a number of less common skin cancers are known as non melanoma skin cancer (NMSC). Basal cell cancer grows slowly and can damage the tissue around it but is unlikely to spread to distant areas or result in death. It often appears as a painless raised area of skin, that may be shiny with small blood vessel running over it or may present as a raised area with an ulcer. Squamous cell cancer is more likely to spread. It usually presents as a hard lump with a scaly top but may also form an ulcer. Melanomas are the most aggressive. Signs include a mole that has changed in size, shape, colour, has irregular edges, has more than one colour, is itchy or bleeds.

Greater than 90% of cases are caused by exposure to ultraviolet radiation from the Sun. This exposure increases the risk of all three main types of skin cancer. Exposure has increased partly due to a thinner ozone layer. Tanning beds are becoming another common source of ultraviolet radiation. For melanomas and basal cell cancers exposure during childhood is particularly harmful. For squamous cell cancers total exposure,irrespective of when it occurs, is more important. Between 20% and 30% of melanomas develop from moles. People with light skin are at higher risk as are those with poor immune function such as from medications or HIV/AIDS. Diagnosis is by biopsy.

Decreasing exposure to ultraviolet radiation and the use of sunscreen appears to be effective methods of preventing melanoma and squamous cell cancer. It is not clear if sunscreen affects the risk of basal cell cancer. Nonmelanoma skin cancer is usually curable. Treatment is generally by surgical removal but may less commonly involve radiation therapy or topical medications such as fluorouracil. In those people whose disease has spread to other areas of their bodies, palliative care may be used to improve quality of life. Melanoma has one of the higher survival rates among cancers, with over 86% of people in the UK and more than 90% in the United States surviving more than 5 years.

Skin cancer is the most common form of cancer, globally accounting for at least 40% of cases. It is especially common among people with light skin. The most common type is non melanoma skin cancer, which occurs in at least 2-3 million people per year. This is a rough estimate, however, as good statistics are not kept. Of non melanoma skin cancers, about 80% are basal cell cancers and 20% squamous cell cancers. Basal cell and squamous cell cancers rarely result in death. In the United States they were the cause of less than 0.1% of all cancer deaths. Globally in 2012 melanoma occurred in 232,000 people, and resulted in 55,000 deaths. Australia and New Zealand have the highest rates of melanoma in the world. The three main types of skin cancer have become more

common in the last 20 to 40 years, especially in those areas which are mostly Caucasian.

A.TYPES OF SKIN CANCER

There are a variety of different skin cancer symptoms. These include changes in the skin that do not heal, ulcering in the skin, discolored skin, and changes in existing moles, such as jagged edges to the mole and enlargement of the mole.

1)Basal cell carcinoma:

Basal cell carcinoma usually presents as a raised, smooth, pearly bump on the sun-exposed skin of the head, neck or shoulders. Sometimes small blood vessels (called telangiectasia) can be seen within the tumour. Crusting and bleeding in the centre of the tumour frequently develops. It is often mistaken for a sore that does not heal. This form of skin cancer is the least deadly and with proper treatment can be completely eliminated, often without scarring.

2)Squamous cell carcinoma:

Squamous cell carcinoma is commonly a red, scaling, thickened patch on sun-exposed skin. Some are firm hard nodules and dome shaped like keratoacanthomas. Ulceration and bleeding may occur. When SCC is not treated, it may develop into a large mass. Squamous cell is the second most common skin cancer. It is dangerous, but not nearly as dangerous as a melanoma.

3)Melanoma:

Most melanomas consist of various colours from shades of brown to black. A small amount of melanomas are pink, red or fleshy in colour; these are called amelanotic melanomas which tend to be more aggressive. Warning signs of malignant melanoma include change in the size, shape, colour or elevation of a mole. Other signs are the appearance of a new mole during adulthood or pain, itching, ulceration, redness around the site, or bleeding at the site. An often-used mnemonic is "ABCDE", where A is for "asymmetrical", B for "borders" (irregular: "Coast of Maine sign"), C for "color" (variegated), D for "diameter" (larger than 6 mm—the size of a pencil eraser) and E for "evolving."

4)Other:

Merkel cell carcinomas are most often rapidly growing, non-tender red, purple or skin colored bumps that are not painful or itchy. They may be mistaken for a cyst or another type of cancer.

B. MELANOMA SKIN CANCER

Melanoma is a type of skin cancer which forms from melanocytes (pigment-containing cells in the skin).

In women, the most common site is the legs, and in men, the back. It is particularly common among Caucasians, especially northern Europeans andnorthwestern Europeans, living in sunny climates. There are higher rates in Oceania, North America, Europe, Southern Africa, and Latin America.[1] This geographic pattern reflects the primary cause, ultraviolet light (UV) exposure in conjunction with the amount of skin pigmentation in the population. Melanocytes produce the dark pigment, melanin, which is responsible for the colour of skin. These cells predominantly occur in skin, but are also found in other parts of the body, including the bowel and the eye. Melanoma can originate in any part of the body that contains melanocytes.

The treatment includes surgical removal of the tumor. If melanoma is found early, while it is still small and thin, and if it is completely removed, then the odds of a cure are high. The likelihood that the melanoma will come back or spread depends on how deeply it has gone into the layers of the skin. For melanomas that come back or spread, treatments include chemo- and immunotherapy, or radiation therapy. Five year survival rates in the United States are on average 91%.[2]

Melanoma is less common than other skin cancers. However, it is much more dangerous if it is not found in the early stages. It causes the majority (75%) of deaths related to skin cancer.[3] Globally, in 2012, melanoma occurred in 232,000 people and resulted in 55,000 deaths.[4] Australia and New Zealand have the highest rates of melanoma in the world.[4] It has become more common in the last 20 years in areas that are mostly Caucasian.[4]

C.DIAGNOSIS

Visual inspection is the most common diagnostic technique. Moles that are irregular in color or shape are typically treated as candidates. To detect melanomas (and increase survival rates), it is recommended to learn to recognize them (see "ABCDE" mnemonic above), to regularly examine moles for changes (shape, size, color, itching or bleeding) and to consult a qualified physician when a candidate appears.

1)ABCDE:

A popular method for remembering the signs and symptoms of melanoma is the mnemonic "ABCDE":

- Asymmetrical skin lesion.
- Border of the lesion is irregular.
- Color: melanomas usually have multiple colors.
- Diameter: moles greater than 6 mm are more likely to be melanomas than smaller moles.
- Enlarging: Enlarging or evolving

However, many melanomas present as lesions smaller than 6 mm in diameter; and all melanomas are malignant when they first appear as a small dot. Physicians typically examine all moles, including those less than 6 mm in diameter. Seborrheic keratosis may meet some or all of the ABCD criteria, and can lead to false alarms. Doctors can generally distinguish seborrheic keratosis from melanoma upon examination, or with dermatoscopy.

Some advocate replacing enlarging with evolution. Certainly moles that change and evolve will be a concern. Alternatively, some practitioners prefer elevation. Elevation can help identify a melanoma, but lack of elevation does not mean that the lesion is not a melanoma. Most melanomas in the US are detected before they become elevated. By the time elevation is visible, they may have progressed to the more dangerous invasive stage.
Nodular melanomas do not fulfill these criteria, having their own mnemonic, "EFG":

- Elevated: the lesion is raised above the surrounding skin.
- Firm: the nodule is solid to the touch.
- Growing: the nodule is increasing in size.

2)Biopsy:

Following a visual examination and a dermatoscopic exam, or *in vivo* diagnostic tools such as a confocal microscope, the doctor may biopsy the suspicious mole. A skin biopsy performed under local anesthesia is often required to assist in making or confirming the diagnosis and in defining severity. Elliptical excisional biopsies may remove the tumor, followed by histological analysis and Breslow scoring. Punch biopsies are contraindicated in suspected melanomas, for fear of seeding tumor cells and hastening the spread of malignant cells.

Total body photography, which involves photographic documentation of as much body surface as possible, is often used during follow-up for high-risk patients. The technique has been reported to enable early detection and provides a cost-effective approach (with any digital camera), but its efficacy has been questioned due to its inability to detect macroscopic changes. The diagnosis method should be used in conjunction with (and not as a replacement for) dermoscopic imaging, with a combination of both methods appearing to give extremely high rates of detection.
3)Laboratory:

Lactate dehydrogenase (LDH) tests are often used to screen for metastases, although many patients with metastases (even end-stage) have a normal LDH; extraordinarily high LDH often indicates metastatic spread of the disease to the liver.

It is common for patients diagnosed with melanoma to have chest X-rays and an LDH test, and in some cases CT, MRI, PET and/or PET/CT scans. Although controversial, sentinel lymph node biopsies and examination of the lymph nodes are also performed in patients to assess spread to the lymph nodes. A diagnosis of melanoma is supported by the presence of the S-100 protein marker.

HMB-45 is a monoclonal antibody that reacts against an antigen present in melanocytic tumors such as melanomas, and stands for Human Melanoma Black. It is used in anatomic pathology as a marker for such tumors. The antibody was generated to an extract of melanoma. It reacts positively against melanocytic tumors but not other tumors, thus demonstrating specificity and sensitivity. The antibody also reacts positively against junctional nevus cells but not intradermal nevi, and against fetal melanocytes but not normal adult melanocytes.

HMB-45 is nonreactive with almost all non-melanoma human malignancies, with the exception of rare tumors showing evidence of melanogenesis (e.g., pigmented schwannoma, clear cell sarcoma) or tumors associated with tuberous sclerosis complex (angiomyolipoma and lymphangiomyoma).

II. EXISTING SYSTEM

A. Computer aided diagnosis system

Computer aided decision support tools are important in medical imaging for diagnosis and evaluation. Predictive models are used in a variety of medical domains for diagnostic and prognostic tasks. These models are built based on experience which constitutes data acquired from actual cases.

The data can be pre-processed and expressed in a set of rules, such as that it is often the case in knowledge-based expert systems, and consequently can serve as training data for statistical and machine learning models.

The general approach of developing a CAD system for the diagnosis of skin cancer is to find the location of a lesion and also to determine an estimate of the probability of a disease. The first step in this paper was to establish a standard general scheme of a CAD system for skin lesions. The proposed scheme is shown in Figure1. The inputs to the computer aided system are digital images obtained by ELM, with the possibility to add other acquisition system such as ultrasound or confocal microscopy. In the first phase preprocessing of image is done that allows reducing the ill effects and various artifacts like hair that may be present in the dermoscopic images. It is followed by the detection of the lesion by image segmentation technique. Once the lesion is localized, different chromatic and morphological features can be quantified and used for classification.

Differentiation of malignant melanoma images demands very fast image processing and feature extraction and classification algorithms. A detailed research is necessary to make the best choice and to set the benchmarks for diagnostic system development and validation. The following section focuses on the description of the major steps that may be involved in skin cancer diagnosis.

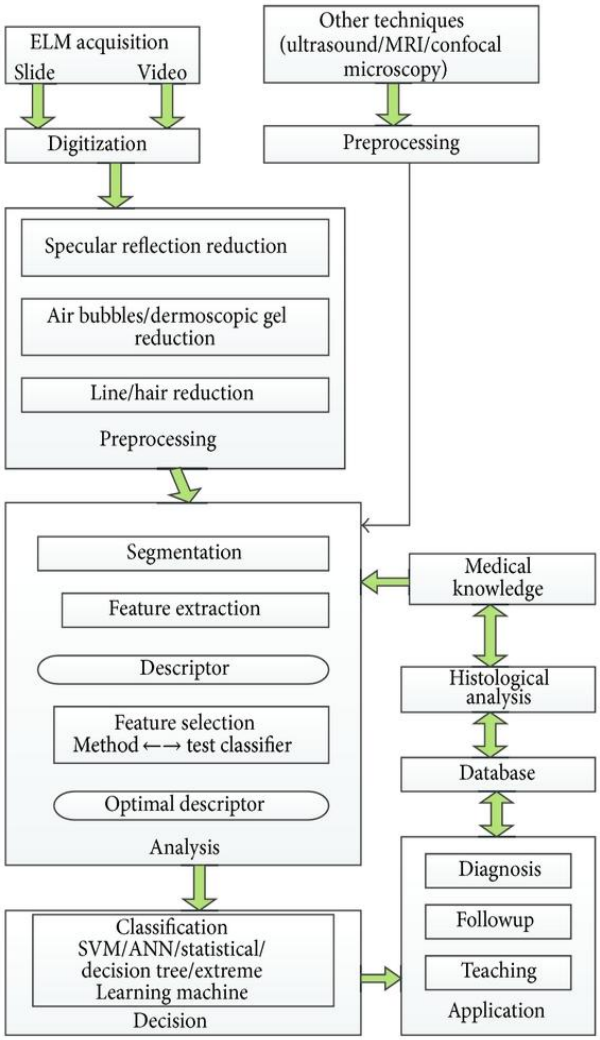

FIG 1: Computer aided diagnostic support system for skin cancer diagnosis.

III. PROPOSED WORK

The aim of automatic computer-aided skin cancer detection system is to detect potentially malignant lesions in the acquired images of affected skin. It consists of 6 general stages [7]. The acquisition of the digital image of affected skin is the first and primary step in image processing.

Once image is acquired, then it goes for pre processing. In first part of pre processing the skin cancer image is converted to gray scale image and then resized. The resized image is split vertically into two equal halves; the left half of the image is flipped and subtracted with other half of the image. The mean intensity value is calculated. Finally; by extracting these features the detection is done which shows the risk probability of the lesion which is present in the image.

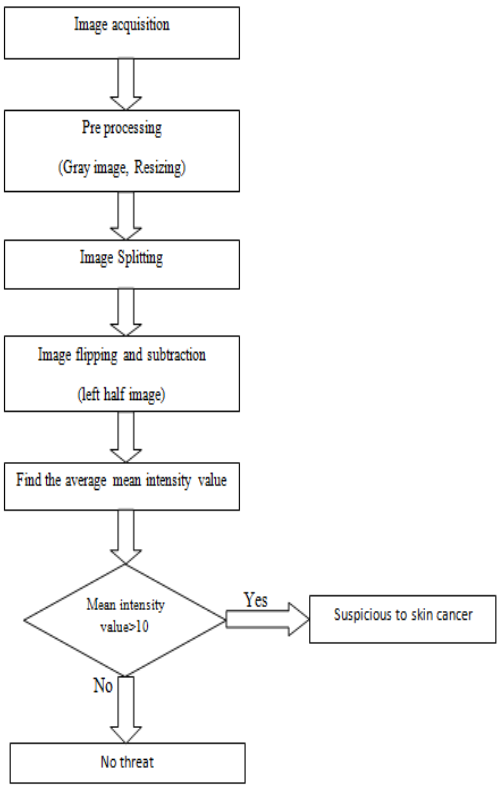

FIG 2: Implementation of asymmetry analysis

A. Image Acquisition

In this paper we have focussed on automatic diagnostic system based on digital dermoscopy images normally collected from different dermoscopy atlases or from dermatologists since it is the most widely used. However, we anticipate that multimodal systems that combine different imaging technologies will further improve the ability to detect melanoma at an earlier stage and reduce the trauma of dermatologic diagnosis.

B. Image Pre-Processing

The main processing step towards a complete analysis of pigmented skin lesion is to differentiate the lesion from the healthy skin. Detection of the lesion is a difficult problem in dermatoscopic images as the transition between the lesion and the surrounding skin is smooth and even for trained dermatologist; it is a challenge to distinguish accurately. It has been observed that dermoscopy images often contain artifacts such as uneven illumination, dermoscopic gel, black frames, ink markings, rulers, air bubbles, and intrinsic cutaneous features that can affect border detection such as blood vessels, hairs, and skin lines and texture. These artifacts and extraneous elements complicate the border detection procedure, which results in a loss of accuracy as well as an increase in computational time. Thus, it requires some pre-processing steps to facilitate the segmentation process by the removal of unwanted objects or artifacts and colour space transformation.

C. Image splitting

The pre-processed image is splitted vertically into two equal halves. For symmetry or normal mole the two halves will be similar but for skin cancer image it will be different.

D.Image Flipping and Subtraction

The one half of the splitted image is flipped and subtracted from another half of the image.

E. Mean Intensity Value

The mean intensity in each of the colour channels is a simple average: loop through each array, add up the values and divide by the number of elements (= no of pixels).

IV. RESULTS

In order to achieve an effective way to identify skin cancer at an early stage without performing any unnecessary skin biopsies, digital images of symmetric and asymmetric skin cancer cell images have been investigated. The proposed method is experimented with skin cancer images using MATLAB R2013a. Fig 3.1, 3.2 and 3.3 show the normal mole images (i.e., symmetry image). Fig 3.11, 3.22 and 3.23 show the split images. The subtracted images are shown in fig 3.31, 3.32 and 3.33.

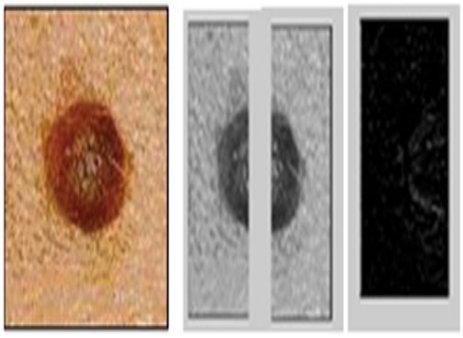

FIG: 3.1 **FIG: 3.2** **FIG:3.3**

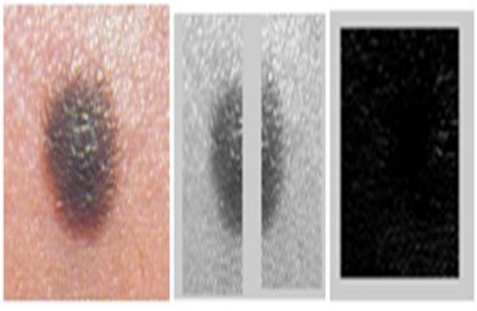

FIG: 3.11 **FIG: 3.22** **FIG: 3.23**

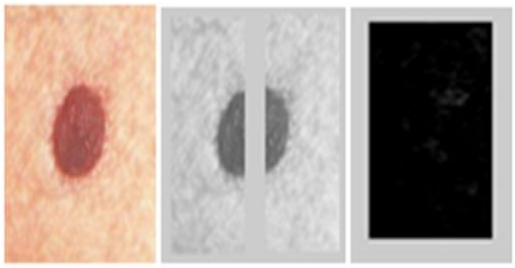

FIG: 3.31 **FIG: 3.3** **FIG: 3.33**

The same way, three skin cancer images are analysed and the results are shown below. Fig 3.41, 3.42 and 3.43 show the cancer affected skin images and their corresponding split images and subtracted images are shown in fig 3.51, 3.52, 3.53 and 3.61, 3.62, 3.63 respectively.

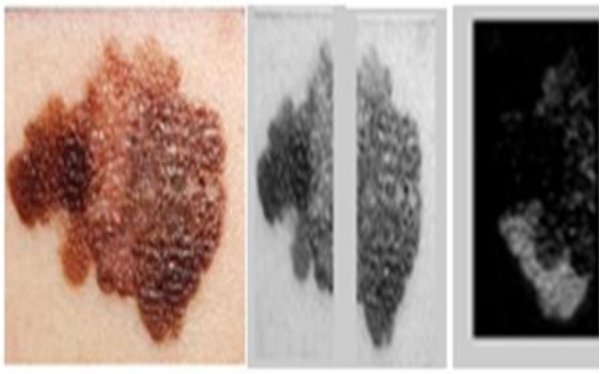

FIG: 3.41 **FIG:3.42** **FIG:3.43**

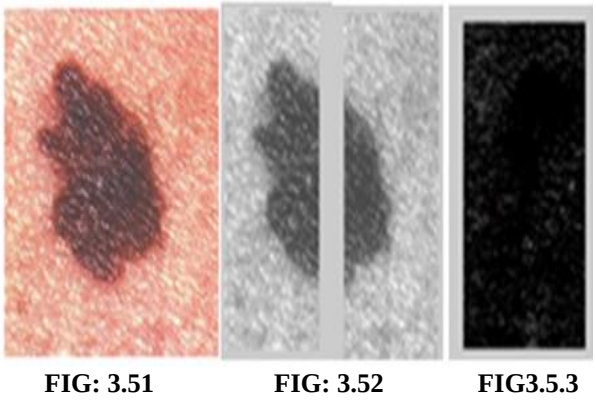

FIG: 3.51 **FIG: 3.52** **FIG3.5.3**

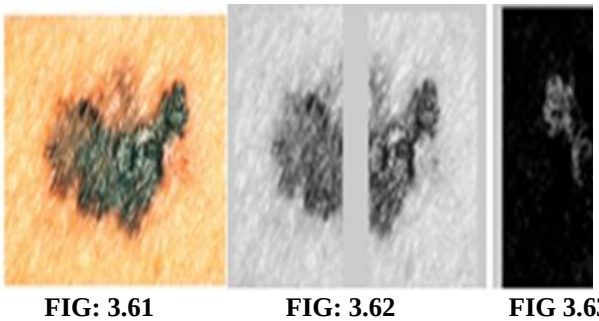

FIG: 3.61 **FIG: 3.62** **FIG 3.63**

The Table-1 shows the mean intensity values of normal and skin cancer affected images, obtained by the proposed method.

Table 1: Mean Intensity Value (Asymmetry Analysis)

NORMAL IMAGE	
Figure. No	**Mean intensity value**
3.1	7.2206
3.2	7.3723
3.3	1.5868
SKIN CANCER IMAGE	
3.41	18.2900
3.42	10.9659
3.43	11.9510

A. DISUSSION

An important aspect of shape understanding is symmetry. Normal moles or freckles are completely symmetrical. In case of skin cancer, spots will not look the same on both sides (i.e.,) they are asymmetric. In these types of images one half of the mole does not match the other. Asymmetry, a critical feature in the diagnosis of skin cancer, is analyzed using Matlab. The processing of skin cancer images are done based on ABCD rule. This rule can be easily learned, rapidly calculated and has proven to be reliable. In this proposed method, asymmetry property of a skin cancer images are used for preliminary detection. For diagnosis, three different symmetric and asymmetric images are processed and the mean intensity values of each image are calculated. The average values or mean pixel intensity values obtained for symmetric and asymmetric images (normal and cancer affected images) are found to be 5.5 and 14. From the analysis the threshold Mean intensity value or a score of 10 can be fixed and a decision can be taken if the mean pixel intensity value of the image under analysis is higher than 10 melanoma or skin cancer can be suspected. And if it is lower than 10 the chances of the occurrence of the diseases can be ruled out.

V. CONCLUSION

The results obtained using three sets of images show that the proposed method has the feasibility for skin cancer diagnosis. However fixing up the threshold value needs the method to be experimented on many images to enhance the authenticity of the method. The method is found to

be simple and has a potential for machine vision of melanoma analysis.

VI. FUTURE ENHANCEMENT

The method can be experimented with at least 50 sets of images to find out the accuracy of it. The clinical verification of the feasibility of the method could be done after this. This system seems to be very helpful to dermatologists, doctors, Clinicians and masses for early detection of skin cancer for further treatment.

REFERENCES

[1] Yana Goncharova, Enas A. S. Attia, Khawla Souid, and Inna V. Vasilenko, "Dermoscopic Features of Facial Pigmented Skin Lesions," Hindawi Publishing Corporation, Dermatology, pp. 1-7, 2013.

[2] Maryam Sadeghi, Timk. Lee, David Mclean, Harvey Lui, and M. Stella Atkins, "Detection and Analysis of Irregular Streaks in Dermoscopic Images of Skin Lesions," IEEE Transactions on Medical Imaging, Vol. 32, No. 5, May 2013.

[3] Darshan Mistrgy, Asim Banerjee., "Discrete Wavelet Transform Using MATLAB," *International Journal of Computer Engineering & Technology.* , vol.4, Issue 2, March- April 2013.

[4] Dhinagar N. J., Celenk M., Akinlar M. A., "Noninvasive Screening and Discrimination of Skin Images for Melanoma Detection," *Bioinformatics and Biomedical Engineering, (iCBBE) 5th International Conference on*, vol.1, no.4, May 2011.

[5] D.E. Elder, Skin cancer: Melanoma and other specific nonmelanoma skin cancers, Cancer Supplement 75 (1) (2014) 245–256.

[6] Ali AI-Haj, M.H.Kabir "Wavelets Pre-Processing of Artificial Neural Networks Classifiers" , IEEE Transactions on Consumer Electronics, Vol. 53 Issue 2, pp. 593-600 , 2010.

[7] Pankaj Agrawal, S.K.Shriwastava and S.S.Limaye, "MATLAB Implementation of Image Segmentation Algorithms", IEEE Pacific,pp.68–73.

[8] T. Tanaka, R. Yamada, M. Tanaka, K. Shimizu, M. Tanaka, "A Study on the Image Diagnosis of Melanoma", IEEE Trans. on Image

[9] Mariam, A.Sheha,Mai, S.Mabrouk, Amr Sharawy, *Automatic Detection of Melanoma Skin Cancer using Texture Analysis*, International Journal of Computer Applications, Volume 42, 2012.