IOSR Journal of Engineering (IOSRJEN)
e-ISSN: 2250-3021, **p**-ISSN: 2278-8719
Vol. 3, Issue 2 (Feb. 2013), ||V1|| PP 52-59

Melanoma Skin Cancer Detection Based on Skin Lesions Characterization

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Abstract: In the last few years, many hospitals and clinics dermatology uses Advanced Computer Vision System based skin lesions characterization for melanoma skin cancer detection of benign skin lesions. Here, we focus malignant melanoma skin cancer,(due to the high concentration of Melanoma-Hier we offer our skin, in the dermis layer of the skin)detection. Reduction in the errorrate of melanoma diagnosis, the very dangerous skin cancer could be treated if detected early is the main focus of the paper. In this we provide a characterization technique used for skin lesions in the last few days ie, ABCD rule Dermoscopy, pattern analysis, analysis of textures, seven point checklist, and Menzies method. We used our ABCD rule Dermoscopy technology for malignant melanoma skin cancer detection.. In this system different step for melanoma skin lesion characterization ie, first the Image Acquisition Technique, preprocessing, segmentation, define feature for skin Feature Selection determines lesion characterization, classification methods. In the Feature extraction by digital image processing method includes, symmetry detection, Border Detection, color, and diameter detection. Of the processing to find features TDV (total dermatoscopic value), we have this value on the basis that melanoma or not.

Keywords*: classification methods, melanoma, skin cancer, ABCD rule, dermoscopy.*

I. INTRODUCTION

Cancer begins when cells in part of the body start to grow out of control. Lesions means possibly abnormal change or difference in a tissue or structure such as the skin. Cancer is an uncontrolled growth of abnormal cells. Skin cancer is the uncontrolled growth of skin cells. It occurs when unrepaired DNA damage to the skin cells (mostly caused by ultraviolet radiation of the sun or tanning beds) Trigger mutations (genetic defects) lead to the skin cells multiply rapidly and malignant tumors form. Some skin cancer can spread and cause damage in the nearby tissues. In some cases, skin cancer can be on vital organs, kills. Sun is the most common cause of skin cancer. But it does not explain that skin cancer does not usually develop on the skin exposed to sunlight. Exposed to environmental hazards, radiation therapy, and even inheritance could play a role. Although anyone can get skin cancer, the risk is greatest for people: Bright skin or bright eyes, a wealth of large, irregular shaped moles, a family history of skin cancer, a history of excessive sunlight or blistering sunburn, lived in large or with year-round sunshine, received radiation treatments. Atypical moles are not cancer, cancer can be you, Figure 1 shows the difference. You can find them in the sun-exposed or sun-protected areas of the body. A typical Moles can be larger (a quarter inch above or greater) and an irregular shape, with notched fading. It can be flat or raised, or the surface smooth or rough. Melanoma skin cancer is a malignant tumor of melanocytes. The melanocytes, the cells produce the dark pigment, melanin, which is responsible for the color of the skin. They mainly occur in the skin, but are also to be found in other parts of the body, including the intestine, and the eye (see the uveal-retinal tissue. melanoma). Melanoma can originate in a part of the body, the melanocytes. Melanoma is less common than other skin cancers. The signs of skin cancer including melanoma, often start as will change the color of the skin. They are usually mixed color, (pink, red, brown, and brown). Three types of skin cancer to be occurred. They are- Basel cell cancer, squamous cell carcinoma and malignant melanoma tumor. The first two are not on other cell, but third a spread quickly. Melanoma is much less common than basal cell and squamous cell skin cancer, but it is far more dangerous. However, it is much more dangerous if it is not found early. It causes the majority (75%) of deaths related to skin cancer. Worldwide, doctors diagnose about 160,000 new cases of melanoma yearly. It is more common in women than in men. In women, the most common site is the legs and melanomas in men are most common on the back. .It is particularly common among Caucasians, especially northern Europeans living in sunny climates. There are high rates of incidence in Australia, New Zealand, North America (especially Texas and Florida), Latin America, and Northern Europe ,with a paradoxical decrease in southern Italy and Sicily. This geographic pattern reflects the primary cause, ultraviolet light (UV) exposure crossed with the amount of skin pigmentation in the population . They can be new growths or precancerous lesions -- changes that are not cancer but could become cancer over time. An estimated 40% to 50% of fair-skinned people who live to be 65 will develop at least one skin cancer.

Learn to spot the early warning signs. Skin cancer can be cured if it's found and treated early. Possible signs of melanoma include a change in the appearance of a mole or pigmented area. Consult a doctor if a mole changes in size, shape, or color, has irregular edges, is more than one color, is asymmetrical, or itches, oozes, or bleeds.

The treatment includes surgical removal of the tumor. If melanoma is found early, while it is still small and thin, and is completely removed the chance of cure is high. The main design issues for the proper characterization of skin lesions of malignant melanoma the image acquisition, the image processing and analysis, the feature extraction, and the classification methodology.

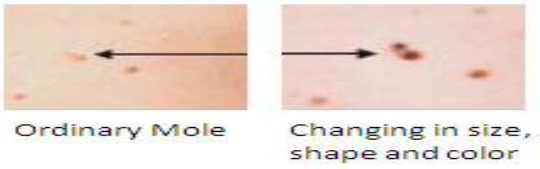


Fig1. Normal and abnormal mole

II. SKIN CANCER BACKGROUND INFORMATION

The body is made up of trillions of living cells. Normal body cells grow, divide, and die in an orderly fashion. During the early years of a person's life, normal cells divide faster to allow the person to grow. After the person becomes an adult, most cells divide only to replace worn-out or dying cells or to repair injuries.

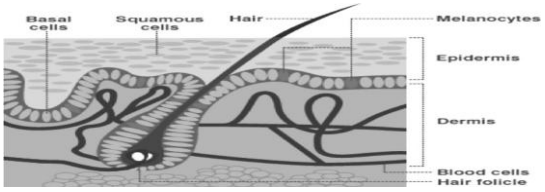


Fig2. Normal skin lesions and main components

Cancer cell growth is different from normal cell growth. Instead of dying, cancer cells continue to grow and form new, abnormal cells. Cancer cells can also invade (grow into) other tissues, something that normal cells cannot do. Growing out of control and invading other tissues are what makes a cell a cancer cell. Cells become cancer cells because of damage to DNA. DNA is in every cell and directs all its actions. In a normal cell, when DNA gets damaged the cell either repairs the damage or the cell dies. In cancer cells, the damaged DNA is not repaired, but the cell doesn't die like it should. Instead, this cell goes on making new cells that the body does not need. These new cells will all have the same damaged DNA as the first cell does. Sometimes the cause of the DNA damage is something obvious, like cigarette smoking. Not all tumors are cancerous. Tumors that aren't cancer are called *benign*. Benign tumors can cause problems – they can grow very large and press on healthy organs and tissues. But they cannot grow into (invade) other tissues. Because they can't invade, they also can't spread to other parts of the body (metastasize). These tumors are almost never life threatening.The skin consist of a number of layer with distinct function and distinct optical properties. The different layers are epidermis, dermis and subcutis . The epidermis is the superficial layer and is largely composed of connective tissues. It also contains the melanin-producing cells, the melanocytes, and their product, melanin. Melanin is a pigment that strongly absorbs light in the blue part of the visible and the UV spectrum. In this way, it acts as a filter that protects the deeper layers of the skin from harmful effects of UV radiation. Within the epidermal layer, there is very little scattering, with the small amount that occurs being forward directed.The result is that all light not absorbed by melanin can be considered to pass into the dermis. The dermis is made of collagen fibers, and in contrast to the epidermis, it contains sensors, receptors, blood vessels, and nerve ends .

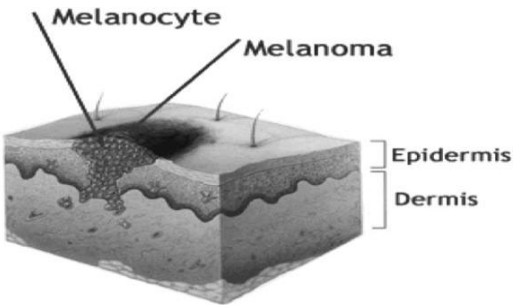


Fig3. Illustration of Melanocytes and Melanoma on skin

Pigmented skin lesions appear as patches of darker color on the skin. In most cases, the cause is excessive melanin concentration in the skin. In benign lesions (e.g., common nevi), melanin deposits are normally found in the epidermis. In malignant lesions (i.e., melanoma), the melanocytes reproduce melanin at a high, abnormal rate. Other names for this cancer include *malignant melanoma* and *cutaneous melanoma*.While they and their associated melanin remain in the epidermis, it is not life threatening. When malignant melanocytes have penetrated into the dermis and they melanin deposits there , thus changing the nature of skin coloration. The presence of melanin in the dermis is the most significant sign of melanoma. Other signs, some of which can be indicative of melanoma are thickening of the collagen fibers in the papillary dermis (fibrosis), increased blood supply at the lesion periphery (erythematic reaction), and lack of blood within the lesion in the areas destroyed by cancer. The color change provide important cue for this. Melanomas can occur anywhere on the skin, but are more likely to start in certain locations. The trunk (chest and back) is the most common site in men. The legs are the most commonly affected site in women. The neck and face are other common sites.

Skin cancers that are not melanoma are sometimes grouped together as *non-melanoma skin cancers* because they develop from skin cells other than melanocytes. They tend to behave very differently from melanomas and are often treated in different ways. Non-melanoma skin cancers include basal cell and squamous cell cancers (by far the most common skin cancers, and actually more common than any other form of cancer). Because they rarely spread (metastasize) to other parts of the body, basal cell and squamous cell skin cancers are less worrisome and are treated differently from melanoma. Merkel cell carcinoma is an uncommon type of skin cancer that is sometimes harder to treat. In this we focus on malignant melanoma tumor skin lesion characterization.

III. RELATED WORK : DIFFERENT METHODS FOR CLASSIFICATION

Ilias Maglogiannis [etal][1] proposed different method are used for skin lesion diaganosis, 1) ABCD rule of dermoscopy 2) pattern analysis 3) Menzies method 4) Seven point checklist and 5) Texture analysis.

A. ABCD rule dermoscopy

In which provide the Asymmetry (A) , Border(B) , Color(C), and Diameter(D) of skin lesion and define the basis for diaganosis by a dermatologist.

B. Pattern Analysis

The pattern analysis method seeks to identify specific patterns, which may be global (reticular, globular, cobblestone, homogeneous, starburst, parallel, multicomponent, nonspecific) or local (pigment network, dots/globules/ moles [5], streaks, blue-whitish veil, regression structures, hypopigmentation, blotches, vascular structures).

C. Menzies Method:

In which look for negative features (Symmetry pattern and single color of presence) and positive features (multiple (five to six) colors, multiple blue/gray dots, broadened network).

D. Seven Point Checklist:

The seven criteria are pigment network, blue-whitish veil, atypical vascular pattern, irregular streaks, irregular dots/globules, irregular blotches, and regression structures. Each one is considered to affect the final assessment with a different weight. The dermoscopic image of a melanocytic skin lesion is analyzed in order to evidence the presence of these standard criteria; finally, a score is alculated from this analysis, and if a total score of three or more is given, the lesion is classified as malignant, otherwise it is classified as nevus.

E. Texture Analysis:

In which quantify texture notation as fine , rough and irregular and to identify , measure and utilize the difference between them. In this paper focus is on ABCD rule dermoscopy for malignant melanoma skin cancer detection.

IV. DIFFERENT STEPS FOR MALIGNANT MELANOMA SKIN CANCER DIAGANOSIS CLASSIFICATION

In this provide the different method of skin lesions characterization for melanoma skin cancer detection.

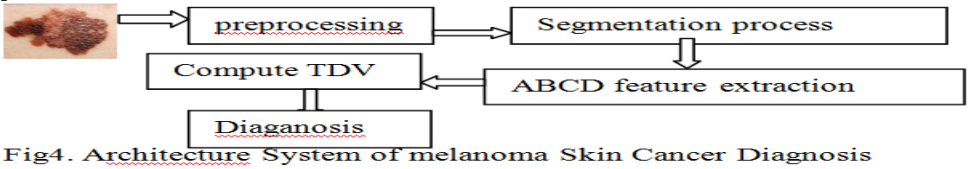


Fig4. Architecture System of melanoma Skin Cancer Diagnosis

A.IMAGE ACQUISITION TECHNIQUE

The first step in expert systems used for skin inspection involves the acquisition of the tissue digital image. The main techniques used for this purpose are the epiluminence microscopy (ELM, or dermoscopy), transmission electron microscopy (TEM), and the image acquisition using still or video cameras. ELM is capable of providing a more detailed inspection of the surface of pigmented skin lesions and renders the epidermis translucent, making many dermal features become visible. TEM, on the other hand, can reveal the typical structure of organization of elastic networks in the dermis. The recently used method is ELM. In this approach,

light is directed from a ring around the periphery of a lesion toward its center at an angle of 45◦, forming a virtual light source at a focal point about 1 cm below the surface of the skin, thus making the surface and subsurface of the skin translucent. The main advantage of transillumination is its sensitivity to imaging increased blood flow and vascularization and also to viewing the subsurface pigmentation in a nevus. The use of commercially available photographic cameras is also quite common in skin lesion inspection systems, particularly for telemedicine purposes. However, the poor resolution in very small skin lesions, i.e., lesions with diameter of less than 0.5 cm, and the variable illumination conditions are not easily handled, and therefore, high-resolution devices with low-distortion lenses have to be used. In addition, the requirement for constant image colors (necessary for image reproducibility) remains unsatisfied, as it requires real time, automated color calibration of the camera, i.e., adjustments and corrections to operate within the dynamic range of the camera and always measure the same color regardless of the lighting conditions.

B. Preprocessing

In this we step we used median filter, which is used for preprocessing ie, smoothening the image [10]. Median filtering is used to minimizing presence of small structures like hairs. In image processing, it is often desirable to be able to perform some kind of noise reduction on an image. The median filter is a nonlinear digital technique, often used to remove noise. Such noise reduction is a typical preprocessing step to improve the results of later processing (for e.g., edge detection on an image) . Median filtering is very widely used in digital image processing because, under certain conditions , it preserves edge while removing noise. It is particularly used to remove salt pepper noise and speckle noise.

Fig5. example of median filtering

C. Segmentation

Segmentation aims to select and separate object from the overall image obtained. Segmentation is the process of finding a connected region within the image with a specific property such as color or intensity or a relationship between pixels that is a pattern.

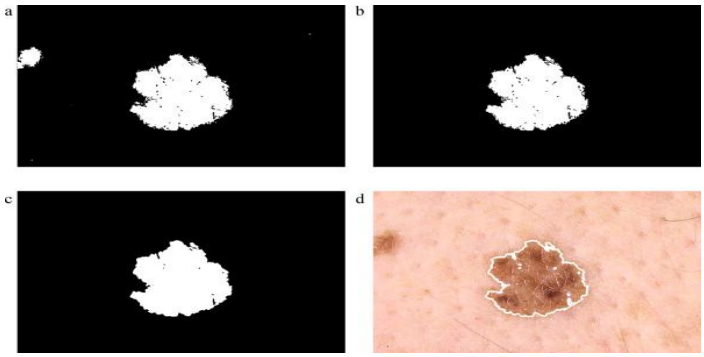


Fig 6. Segmentation process in skin lesion

Segmentation consist of down sampling, filtering and edge detection has been done by Chastine Fatichah et al [10]. The down sampling used to decrease the number of pixels and eliminate some information from the image[11].

D. *Feature Extraction*

In this section, we will examine the features, i.e., the visual cues that are used for skin lesion characterization. Similarly to the traditional visual diagnosis procedure, the computer-based systems look for features and combine them to characterize the lesion as malignant melanoma or benign skin lesion. The diagnosis method for Melanoma skin cancer using ABCD rule[1] .

ABCD Rule: The ABCD rule investigates the Asymmetry(A),

Border (B), Color (C), and Diameter (D) of the lesion and defines the basis for a diagnosis by a dermatologist.

Most moles on a person's body look similar to one another. If a mole or freckle that looks different from the others then that has any characteristics of the ABCDs of melanoma should be checked by a dermatologist. It could be cancerous. The ABCDs are important characteristics to consider when examining your moles or other skin growths. The features have to be measureable and of high sensitivity. The ABCD feature extraction is one of process to extract the important features. Asymmetry Extraction is used to obtain information Asymmetry Index and lengthening index of the object. If the Asymmetry Index value greater the chances are that the lesion is melanoma. Extraction Border Irregularity is used to obtain information Compactness Index from the object. Extraction color change is used to obtain information Color Homogeneity and correlation between photometry and geometry of the object vertically and horizontally. The diameter provide the diameter value of the skin lesion .

1). *Asymmetry:*

Normal moles are symmetrical. A normal mole is round, whereas a suspicious mole is uneven. Asymmetry means one half of a mole does not match the other half.. When checking your moles or freckles, draw an imaginary line through the middle and compare the two halves in terms of border, color and dermatoscopic structure. If they do not look the same on both sides, then it become melanoma.

Fig7. Symmetrical and asymmetrical mole

The two value of asymmetry feature is Asymmetry Indux and lengthening indux can be used to measure asymmetry .

The Asymmetry Indux calculated we using the below equation,

$$AI = \frac{1}{2}\sum_{k=1}^{2}\frac{\Delta Ak}{Al}$$

Where k is major and minor axis, $\Delta A\kappa$ is non-overlapping area of lesion.

Lengthening Index : This measurement is used to describe the elongation of a lesion. Elongation injury is related to Eigen value λ', λ" from the inertia tensor matrix. This is defined by the ratio of moment of inertia λ' about the major axis using λ" moment of inertia about minor axis.

$$A = \frac{\lambda^{1}}{\lambda^{11}}$$

2). *Border:*

Melanoma lesions often have uneven borders. A normal mole has a clear-cut border with the surrounding skin, whereas the edges of a suspect mole may be irregular. If the border or edges of the mole are ragged, blurred, or irregular, have it checked by a dermatologist.

Fig8. Even and uneven border

Density index (Compactness Index / CI) is the measurement of the most popular form of barrier which 2D objects estimate unanimous. However, this measure is very sensitive to noise along the boundary term amplified by the square of the perimeter

$$\mathrm{CI} = \frac{(PL)^2}{4\prod Al}$$

PL is perimeter lesion:

To find PL value, surgery Robert edge detector to detect edges. Robert is a differential technique, the differential in the horizontal direction and the differential in the vertical direction, with the added conversion process after the differential binary. Binary conversion technique proposed is the conversion to level the distribution of a binary black and white.

3). *Color:*

A mole that does not have the same color throughout or that has shades of tan, brown, black, blue, white, or red is suspicious. Normal moles are usually a single shade of color. Normal moles are uniformly tan or brown, but cancerous moles may appear as mixtures of red, white, blue, brown, purple, or black. A mole of many shades or that has lightened or darkened should be checked by a doctor.

Luminance histogram of injuries is used to evaluate the color distribution in the skin lesions. The number of color present is checked it is more than one in vertically and horizontally then it has possibility of melanoma. The skin lesion contain combination of three or more such as red, brown ,pink, and blue horizontally and vertically then we declared that it is melanoma.

Fig9. Mole have one color and multiple color

4).Diameter:

A mole is suspicious if the diameter is larger than the eraser of a pencil. Normal moles are usually less than 1/5 in (5 mm) in diameter, a skin lesion greater than this may be suspected as cancerous.

Fig10. Normal and abnormal mole diameter

Melanoma tend to grow larger than common moles, and especially the diameter of 6mm. Because the wound is often irregular forms, to find the diameter, drawn from all the edge pixels to the pixel edges through the mid-point and averaged.

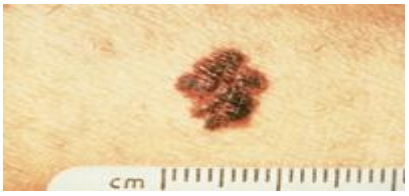


Fig11. Measuring diameter of the mole

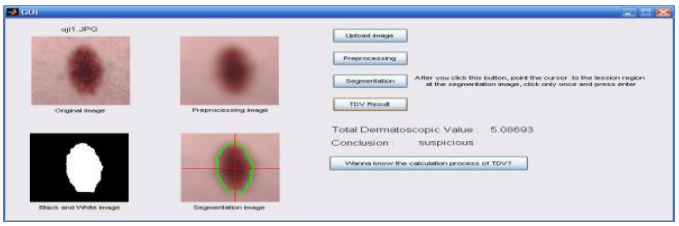
V. Compute Total Dermatoscopic Value

After the value of four component is found, then calculate TDV (Total Dermatoscopic Value). To get the TDV values, then the formula obtained as follows:

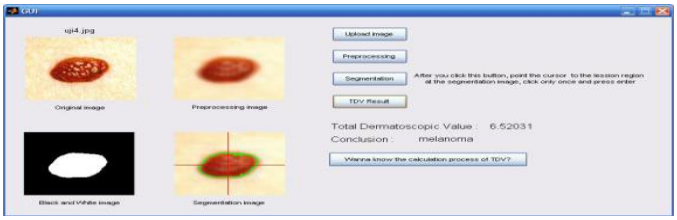
$TDV = A * 1.3 + B * 0.1 + C * 0.5 + D * 0.5$

Then the value obtained has the following conclusion:

¾ 1.00 – 4.75 – benign skin lesion
¾ 4.75 – 5.45 – suspicious
¾ more than 5.45 – melanoma



(a)



(b)

Fig10. a and b represent the implementation of the system

The above figure show the implementation of the proposed system. The following process to be take place their ie, first of all 'upload' button click then upload the skin lesion. Next click on 'preprocessing' we get the image after the filtering done . Then click on the 'segmentation' button we get edge detected with segmented output. At last click on the 'Try Result' we get the skin lesion is included in which category.

V. LEARNING AND TESTING PHASE

After the feature selection, the other two phase are learning and testing. During the learning phase the feature values are extracted from the sequence of digital images ie, skin lesions image and the matrics value to be obtained . Using these to values to evaluate the total dermatoscopic value(TDV). These getting value based classification into two class take place. These to be stored in the machine.The three-layer mechanism, include input layer ,hidden layer and output layer, that inherent to the support vector machine (SVM) is a popular algorithm for data classification .SVM have recently gained prominence in the field of machine learning and pattern classification. It is a supervised learning algorithm , allow the expansion of the information provided by a learning dataset as a linear combination of a subset of the data in the learning set (support vectors).Given a set of training examples, each marked as belonging to one of two categories , an SVM training algorithm builds a model that assigns new example into one category or the other. In machine learning classification is the problem of identifying which of a set of categories the new observation belongs, on the training set of data containing in the machine.Neural networks are networks of interconnected nodes composed of various stages that take some of the observed properties of biological nervous systems and make on the analogies of adaptive biological learning.

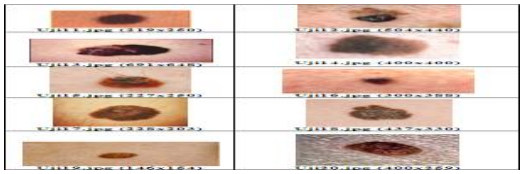


Fig11. Data samples provided for learning

Learning occurs through learning over a large set of data as shown above, where the learning algorithm iteratively adjusts the connection weights (synapses) by minimizing a given error function. These vectors locate a hypersurface that separates the input data with a very good degree of generalization into two possible two class. The support vector machine (SVM) methodology is employed to improve the generalization error rate and the computational efficiency .The SVM algorithm is based on learning, testing, and performance evaluation, which are common steps in every learning procedure. Learning involves optimization of a convex cost function where there are no local minima to complicate the learning process. Testing is based on model evaluation using

the support vectors to classify a test dataset. Performance evaluation is based on error rate determination as the test dataset size tends to infinity. The main problem occurring is we need large learning examples.

VI. CONCLUSIONS

In which we use different method to find skin lesion characterization. The different methods are image acquisition, segmentation, preprocessing, define features, feature selection and classification methods. Here we use different image feature extraction through image processing methods are symmetry detection, border detection, color detection and diameter detection. Based on these features we calculate a TDV , the value of TDV with SVM based classified into malignant melanoma or not. After these done the Learning and Testing phase using neural network based SVM. In future work include new feature evolving, then the ABCD rule change to ABCDE rule. These help to provide more accurate result than the ABCD rule.

REFERENCES

[1] Overview of Advanced Computer Vision Systems for Skin Lesions Characterization Ilias Maglogiannis, Member, IEEE, and Charalampos N. Doukas, Student Member, IEEE
[2] ABCD Feature Extraction for Melanoma SkinCancer Diagnosis.
[3] Directional Analysis of Image Textures for Feature Extraction and Segmentation.
[4] [SVM-based Texture Classification and Application to Early Melanoma Detection.
[5] T. K. Lee, M. S. Atkins,M.A.King, S. Lau, andD. I.McLean, "Countingmoles automatically from back images," IEEE Trans. Biomed. Eng., vol. 52, no. 11, pp. 1966–1969, Nov. 2005.
[6] S. Umbaugh, Y. Wei, and M. Zuke, "Feature extraction in image analysis," IEEE Eng. Med. Biol., vol. 16, no. 4, pp. 62–73, Jul./Aug. 1997.
[7] World Health Organization, Ultraviolet Radiation and the INTERSUN Programme. (2007. Dec.). [Online]. Available: http://www. who.int/uv/faq/skincancer/en/.
[8] R. Marks, "Epidemiology of melanoma," Clin. Exp. Dermatol., vol. 25, pp. 459–463, 2000.
[9] E. Claridge, S. Cotton, P. Hall, and M. Moncrieff, "From colour to tissue histology: Physics-based interpretation of images of pigmented skin lesions," Med. Image Anal., vol. 7, pp. 489–502, 2003.
[10] Chastine Fatichah, Bilqis Amaliah, Rahmat Widyanto, " Skin Lesion Detection using Fuzzy Region Growing", Proceeding of Industrial Informatics Seminar (IIS), 2009.
[11] Harald Ganster, Axel Pinz, Reinhard Röhrer, Ernst Wildling, Michael Binder, and Harald Kittler, "Automated Melanoma Recognition", IEEE Transactions on Medical Imaging, Vol. 20, No. 3, March 2001.