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Non-Invasive Screening and Discrimination of Skin Images For Early Melanoma Detection

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***Abstract*- This paper presents an experimental investigation of human skin. Human skin is a complex surface, wit fine scale geometry that makes its appearance difficult to model. Also, the conditions under which the skin surface is viewe and illuminated greatly affect its appearance and properties. It can be easily examined with the eyes, however, man particular aspects of the skin are better evaluated by non-invasive methods. Then it describes a method that helps i detection of suntanned or precancerous skin using gross-over all image segmentation. A skin cancer can become highl invasive and lethal if not treated at the earliest possible stage and it aims to eliminate the need for a patient to under g biopsy as a means of basic diagnosis for melanoma. Generally UV rays from the sun and other sources can damage ski cells causing cells to grow abnormally. Melanoma is considered as one such dangerous type of skin cancer. The main caus of melanoma is excessive exposure to UV radiation reaching the skin. When compared to the normal skin the structure abnormal skin as an irregular outer epidermal layer as well as the inner dermal layer. Skin cancer can be detected usin ABCB rule with good diagnostic accuracy as it is easy to detect melanoma by ABCD parameters. In this paper all types skin can be tested viz normal skin, suntanned and pre-cancerous as well as it diagnosis the freckle(mole) and congenita nevi(moles that appear at birth).**

Index Terms-*Melanoma, skin cancer, biopsy, congenital nevi.*

1.INTRODUCTION

The skin is the outer covering of human's body and is body's largest organ. Normal skin cells are reproduced in an orderly controlled way and new cells are formed regularly in order to replace the old, damaged cells. Normally, new cells are divided at a controlled rate to keep the overall number of cells as nearly a constant. The cancer cells[1] are abnormal and can not be controlled by the body's normal regulatory mechanism. This abnormal cell growth is called tumor. Generally, the skin cancers fall into basal cell carcinoma, squamous cell carcinoma, or malignant melanoma[4].

The basal cell carcinoma grows slowly, it is painless, and often presents with a shiny or translucent raised margin. It usually appears as a small, fleshy bump or node on the head, neck and hands. The squamous cell carcinoma usually appears in elderly patients, it may grow rapidly in size to form a large mass and sometime break down to form an ulcer. It is mostly founded on ear, the face and mouth. When properly treated, the cure rate for both basal cell and squamous cell carcinoma are 95 percent[4].

While the malignant melanoma is a highly malignant skin cancer it grows rapidly and sometimes with different colors and with irregular shapes. Melanoma begins in melanocytes, the skin cells that produce the dark protective pigment called melanin. The melanin is responsible for suntanned skin which acts as a partial protection against sun light. Melanoma cells usually continue to produce melanin leading to the cancers with mixed shapes and colors. Melanoma may suddenly appear without warning and also may begin in or near a mole or other dark spot in the skin. So it is important to know the location and appearance of the moles, especially when there is a sudden change. The main cause of melanoma is excessive exposure to ultraviolet(UV) radiation reaching the skin. UV rays from the sun and other sources(such as tanning booths) can damage skin cells, causing the cells to grow abnormally. If melanoma is found and treated in its early stages the chances of recovery are very good but if the diagnosis becomes late, melanoma can grow deeper into the skin and spread to other parts of the body. Once melanoma has spread to other parts of the body beyond the skin, it is difficult to treat.

Most of the proposed techniques require segmentation [2] process that considers being a fatal problem due to the irregularity of the tumor, where dermoscopy views of histological tissues show structures mostly arranged in a variety of patterns.

Melanoma typically grows horizontally within the epidermis. It then penetrates into the dermis. Therefore, accurate diagnosis of malignant melanoma at an early stage, leading to earlier treatment is crucial to successful cancer management and is a crucial issue for dermatologists. Earlier detection[13] and therapy also lead to less mortality and decreased cost of therapy.
The standard method to evaluate a skin growth to rule out melanoma is by biopsy followed by histopathological examination. The challenge lies in identifying the lesions that have the highest probability for being melanoma[4].
There are different layers [3] in the skin as shown in Fig 1.

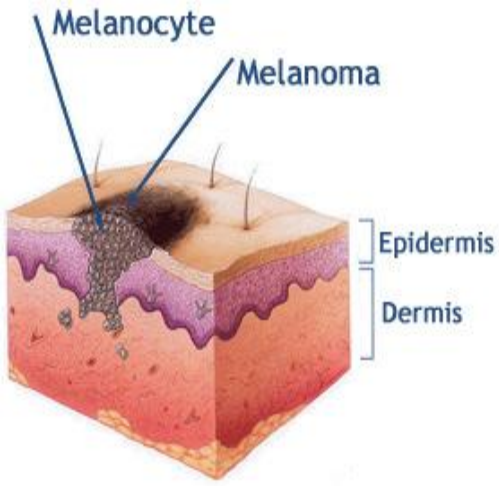


Fig 1: Structure of Melanoma

2.PROPOSED SYSTEM

Development of non-invasive tools to improve early diagnosis results in 2 approaches, dermoscopy and digital image analysis. In real world applications, it is evident that images not only contain instances of the objects of interest, but also large amounts of background pixels. The processing consists of extracting the useful and desired information of the melanoma.
The proposed steps of skin cancer detection are shown in Fig 2.

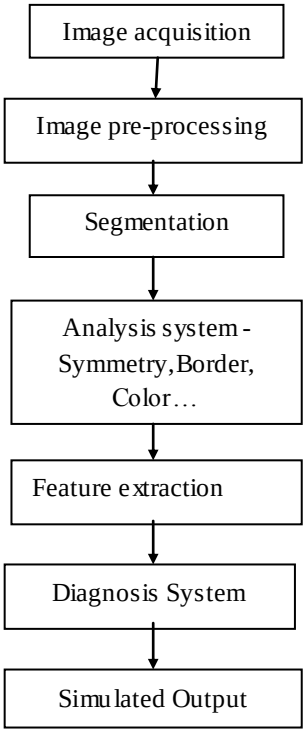


Fig 2: Skin cancer detection and diagnosis

2.1.Image acquisition

A physical object is digitally imaged and the data transferred to memory. The image is filtered to reduce noise and to remove unnecessary features such as light, flecks. A skin cancer detection is the skin inspection to find melanoma and it involves acquisition of the digital image of affected skin. There are various techniques to acquire skin cancer lesion images are given below.

The available techniques are Video RGB Camera[6], Still CCD Camera, Tissue microscopy, ELM[12] or Dermoscopy[8], Transmission electron microscopy (TEM), Ultravoilet illumination[14], Computed tomography (CT), Position emission tomography (PET), MRI.
Mostly ELM or dermoscopy is used for the diagnosis of skin cancer. It uses a hand held lighted magnifier to analyze skin lesions by observing newly defined and descriptively named subsurface structures. Dermoscopes usually facilitate a 10-times magnification of the skin.

2.2.Image Pre-processing

Digital images of skin cancer are collected in Bitmap or JPEG format from different sources. Generally indexed images with linear monotonic color maps are used so that RGB images are converted to indexed images. It prepares the image from ordinary image to first RGB then grayscale and at the end binary.
It basically involves improvement or enhancement of image, which includes noise removal, edge highlighting, sharpening, deblurring, brightening, change in image contrast, masking, hair removal, cropping or resizing. Fig. 3 shows the steps in image
preparation.

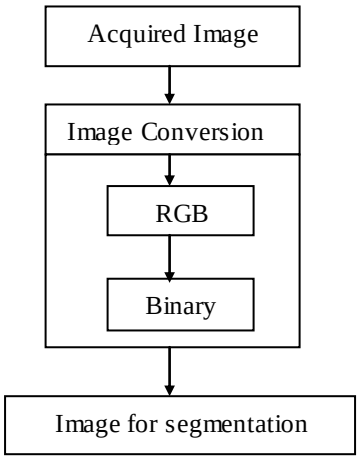


Fig 3 : Image preparation.

2.3.Image Segmentation

It is a process of image partitioning into multiple segments or regions or structures of interest, so that the contents of each region have similar characteristics. It is a process of extracting and representing information from the image to group pixels together with region of similarity.
There are many image segmentation techniques [2] , such as, threshold based segmentation, edge based segmentation, region based segmentation, clustering based image segmentation, markov random field based segmentation or hybrid segmentation techniques, used in image processing.
In order to detect the border of melanomas, there are numerous techniques intended for edge detection. One of the

most applicable is the Canny Edge Detection, which firstly smoothes the image to eliminate noise. It then finds the image gradient to highlight regions with high spatial derivatives. The algorithm then tracks along these regions and suppresses any pixel that is not at its maximum (no maximum suppression). The remaining pixels that have not been suppresses are treated by two thresholds and if the magnitude is below the first threshold, it is set to zero. If the magnitude is above the high threshold, it is made an edge. And if the magnitude is between the two thresholds, then it is set to zero.

2.4.Feature Extraction

Feature extraction is a sub division of improved image into constituent parts or isolation of some aspects of an image for identifying or interpreting meaningful object forms, which includes finding lines, circles or specific shapes and identifying pimples, white heads or black heads, etc. The purpose of feature extraction is to reduce the original data set by measuring certain properties, or features, that distinguish one input pattern from another.

2.5.Feature Analysis

Image analysis techniques involves the measurement of extracted image features[7]. Measurement of image features for diagnosis of melanoma requires that first, the lesions be detected and localized in an image. It is essential that lesion boundaries are determined accurately so that measurements, e.g. maximum diameter, asymmetry, irregularity of the boundary, and color characteristics can be accurately computed. The most significant features are selected to increase the detection accuracy.

2.6.Skin health Diagnosis System

Skin Health Diagnosis is a process of identifying a skin texture or problem by its signs, symptoms. Diagnosis system is a system that can be used to analyze any problem by answering some questions that lead to a solution to the problem. When melanomas occur, they usually arise from pigmented nevi (moles) that are large (diameter > 6mm), asymmetric, with irregular borders and coloration.

ABCD(E) Rule

The earlier melanoma is diagnosed, the better the outcome. Everyone should get into the habit of self-examination to detect changes in the appearance of moles, blemishes, freckles, and other marks on the skin[11].

While the ABCD rule is a good one, that all melanomas may not manifest with these signs. Often, these are perfectly harmless, and thus the ABCD rule is not absolute. But it is far better to be safe, and self-examination by the ABCD rule is still the best way for the general public to be vigilant.

Dermatologists have considered adding the letter "E" to the rule to signify an "evolving lesion." Many consider this to be the most important criterion for evaluating a skin lesion. Basically, any mole or lesion that has evolved, or changed, is cause to see a dermatologist.

In 1985, New York University devised the ABCD acronym (Asymmetry, Border irregularity, Color variegation, Diameter > 6mm). Stolz W [15]
established this and also known as the ABCD rule of dermatoscopy[10].The characteristics needed to diagnose a melanoma as malignant and are explained as

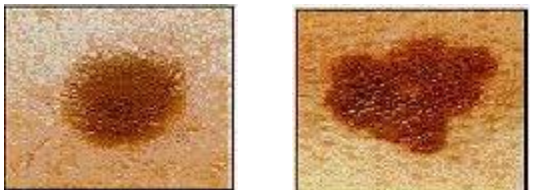
(A) Asymmetry - one half does not match the other.
Symmetry or asymmetry in zero, one, or two orthogonal axes are considered. Also color, texture, and shape must be taken into account.

(B) Border irregularity - the edges are ragger, notched or blurred. The lesion is divided into eight radial pieces which are then labeled as showing a sharp cut-off with the surrounding skin or not.

(C) Color - the pigmentation is not uniform. The presence of up to six known colors may be detected - white, red, light brown, dark brown, slate blue, and black.

(D) Diameter - the width is greater than 6mm. Differential structures with at least five patterns are relevant for specific types of lesions. Any growth of a mole should be of concern.

Asymmetry

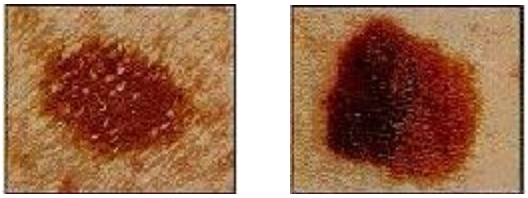


Symmetrical Asymmetrical

Border

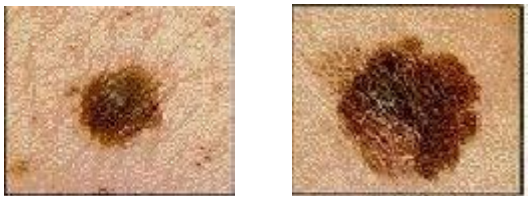
Even Edges Uneven Edges

Color



One Shade Two or More Shades

Diameter



Smaller than 6mm Larger than 6mm

Fig 4 :ABCD rule for detection of skin cancer.

Simulated Output

The image is simulated using MATLAB[9] software, the output detects whether the skin image is cancer or not. In this project the output is obtained by simulating different

images such as abnormal skin(skin cancer),normal skin, moles etc. The simulated output displays 9 images which include:
Original image, binary image, image indication of skin not normal, binary mask, masking, no holes, border removed, final binary mask and final image.

3. EVALUATION

We evaluated the system using MATLAB[9].This can also be evaluated by OPEN CV or HALCON software. The program is same but the coding or implementation differs.

After the image is simulated using MATLAB[9] the different images are determined whether the image is cancer or not.

- If the image is of cancer the final image obtained shows the border of the cancer affected area.
- If the image is of not cancer or the normal skin or any type of skin allergy, the final image obtained shows no border and the remaining area would be shown black or which indicates it has not abnormal skin(skin cancer).

Output image with cancer

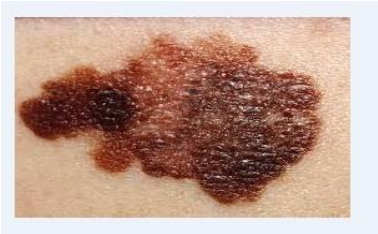


Fig 5: Original image

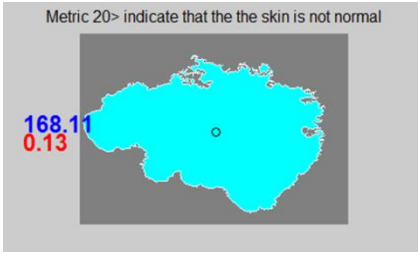


Fig 6: Image depicts roundness and diameter

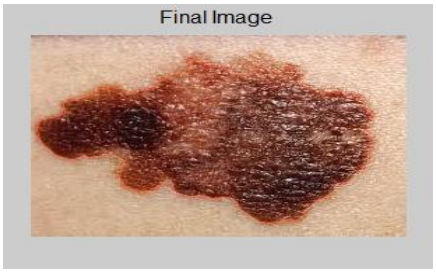


Fig 7: Outline of affected skin

Output image with cancer

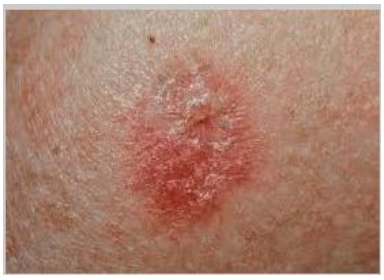


Fig 8: Original image

The image indicates that it not cancer so roundness and diameter is not shown. It is just some kind of skin allergy. So the original image will be same as final image.

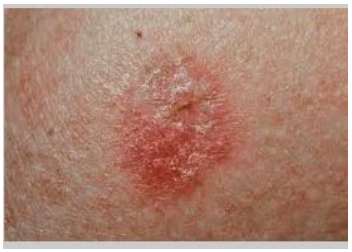


Fig 9:Final image

4.SOURCES OF MELANOMA

4.1 Early Detection

The importance of early detection of melanoma cannot be overstated. When melanoma[11] is found and treated early, the chances for long-term survival are excellent. Five-year survival rates for patients with early-stage (Stage I) melanoma exceed 90 to 95%. As melanoma progresses, it becomes increasingly more devastating and deadly. In later-stage disease, 5-year survival rates drop to less than 50%.The good news is that with early detection, survival rates have improved steadily in recent years, and 85% of diagnosed patients enjoy long-term survival after simple tumor surgery. 2 The first sign of melanoma is often a change in the size, shape, or color of an existing mole or the appearance of a new mole. Since the vast majority of primary melanomas are visible on the skin, there is a good chance of detecting the disease in its early stages.
You can play a vital role in early detection of melanoma through:

- Skin self-examination
- Regular physical examinations, including a skin examination
- A free annual skin cancer screening, available in many parts of the country

4.2 Staging Melanoma

When a biopsy shows the presence of melanoma, the next step is to determine the cancer's stage, how large the tumor[1] is and how far it has spread. These findings will form the basis for decisions about how to treat the disease most effectively. The official guidelines for staging melanoma were updated in 2009 by the American Joint Committee on Cancer (AJCC), a distinguished group of

experts from national healthcare organizations and major cancer centers around the country. Member organizations include the American Cancer Society, the American College of Surgeons, the American Society of Clinical Oncology, and the Centers for Disease Control and Prevention. Melanoma Center's Staging Tool will guide you through the process of identifying the stage of your melanoma.

4.2.1 Factors of Prognosis

The revised melanoma staging system is based on the risk factors most important in determining prognosis. They include:

- Tumor thickness (also known as Breslow thickness): how deeply the tumor has penetrated the skin. Thickness is measured in millimeters (mm). Thinner tumors carry a more favorable prognosis than thicker tumors. The thicker the tumor, the greater the risk of tumor metastasis.
- The presence or absence of tumor ulceration.
  Ulceration is a condition in which the epidermis that covers a portion of the primary melanoma is not intact. Ulceration is determined by microscopic evaluation of the tissue by a pathologist, not by what can be seen with the naked eye. Ulcerated tumors pose a greater risk for metastatic disease than tumors that are not ulcerated.
- The number of metastatic lymph nodes.
  The greater the number of lymph nodes containing melanoma, the less favorable the prognosis.
- Mitoses within the primary tumor.
  Mitoses are active cell division of the tumor and can be defined in terms of number. This will be determined by the pathologist who diagnoses the melanoma and should be reported for each primary melanoma within the pathology report. The more mitoses, the more aggressive the tumor seems to be growing.
- Whether metastasis to the lymph nodes is microscopic or macroscopic.
  Micrometastases[1] are tiny tumors not visible to the naked eye. They can be detected only by microscopic evaluation after sentinel lymph node biopsy or elective lymph node dissection. Macrometastases can be felt during physical examination or seen by the naked eye when inspected by a surgeon or pathologist. Their presence is confirmed by lymph node dissection or when the tumor is seen to extend beyond the lymph node capsule. Macrometastases carry a less favorable prognosis than micrometastases.
- The site of distant metastasis.
  Distant metastases[3] to the skin, the subcutaneous tissue, or distant lymph nodes carry a relatively better prognosis than distant metastases to any other site in the body.
- Level of serum lactate dehydrogenase (LDH).
  LDH is an enzyme found in the blood and many body tissues. Elevated LDH levels usually indicate the presence of metastatic disease and a less favorable prognosis than normal LDH levels.

4.2.2 Prevention

No cancer, including melanoma, can ever be prevented with 100% certainty. Some genetic and hereditary risk factors for melanoma, such as skin type and family history, cannot be changed. Sometimes melanoma[4] may develop despite your best efforts to prevent it from occurring. The good news is the risk factors for melanoma are well known. An awareness of hereditary risk factors allows you to take steps to detect the disease before it has a chance to grow and spread, and when treatment is more likely to result in a cure. (See Early Detection for more information.) An awareness of the environmental risk factors allows you to reduce significantly your risk of developing melanoma.

- The primary environmental risk factor for melanoma is overexposure to the sun's damaging rays, known as ultraviolet (UV) radiation. In this section, you will find important information to help you protect yourself from the UV radiation and other tips to help you reduce your risk of melanoma.
- You are likely to receive about 80% of your lifetime sun exposure during the first 18 years of life. Therefore, sun safety for infants, children, and teens is vital to preventing skin cancer in later years.

4.2.3 Treatment

After the diagnosis of melanoma, your doctor will discuss a course of action based on a number including your age, general health, and the location, type, and stage of your disease.

Treatments[13] are available for all people with melanoma. In many cases, the standard treatment is surgery to remove the tumor and a surrounding area of normal appearing skin. Sometimes surgery is followed by additional therapy such as immunotherapy, chemotherapy, radiation, or a combination of these treatments. Chemotherapy and immunotherapy are also used to treat advanced or recurrent melanoma.

A variety of experimental treatments for advanced inoperable, and operable, potentially curable melanoma are being investigated in clinical trials, research studies to evaluate new therapies and improve cancer care. These studies are responsible for most of the advances in cancer prevention, diagnosis, and treatment.

In this section, you will find information about types of treatment for melanoma, standard treatments for each stage of melanoma, as well as experimental treatments for which you may be eligible.

5.CONCLUSION

Melanoma considered the most dangerous type of skin cancer. As melanoma diagnosis requires experience, where early stages may look identical to harmless moles. Automatic diagnosis is essential tool for less experience physicians. In this work, an automated system of melanoma classification was applied on dermoscopy images to be an assisting tool in the early diagnosis of malignant melanoma and melanocytic nevi lesions.

Digital photography with high color reproducibility that enables quantitative image analysis is quite beneficial in dermatology[5] and other fields. To put this technology into practical use, the clinical evaluation is an essential issue for future work in addition to the development of handy imaging devices.

There are many techniques to detect cancer i.e by Thermal imaging ,Wavelet transform[8] etc.

The result of more than 96% correctly segmented lesion images which reflects a very reliable detection for the special

task of skin lesion detection. Skin cancer diagnosis system identifies and recognizes skin cancer symptoms and diagnoses melanoma in early stages. With the proper image input using different Digital Image Processing steps, doctors can get very good help from such diagnostic systems. We are proposing to use ABCD rule as its diagnostic accuracy has been reported to be 76%. This simulation will save doctor's time and also can be used for regular monitoring skin cancer development in patients. Early diagnosis is more than 90% curable and late is less than 50%.

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