Skin Cancer Detection Using Digital Image Processing

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Abstract: Detection of skin cancer in the earlier stage is very important and critical. In recent days, skin cancer is seen as one of the most hazardous forms of the cancers found in humans. Skin cancer is found in various types such as Melanoma, Basal and Squamous cell Carcinoma among which Melanoma is the most unpredictable. The detection of Melanoma cancer in early stage can be helpful to cure it. Computer vision can play an important role in Medical Image Diagnosis and it has been proved by many existing systems. In this paper, we present a computer-aided method for the detection of Melanoma Skin Cancer using Image processing tools. The input to the system is the skin lesion image and then by applying novel image processing techniques, it analyses it to conclude about the presence of skin cancer. The Lesion Image analysis tools checks for the various Melanoma parameters Like Asymmetry, Border, Colour, Diameter, (ABCD) etc. by texture, size and shape analysis for image segmentation and feature stages. The extracted feature parameters are used to classify the image as Normal skin and Melanoma cancer lesion.

Keywords: Melanoma; Digital Image; Carcinoma

1. Introduction

In skin health, diagnosis or diagnostics is the process of identifying a skin texture or problem by its signs, symptoms and the result of various diagnosis procedures. The conclusion reached through this process is called a diagnosis. The 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. Skin cancer is a malignant tumour that grows in the skin cells and accounts for more than 50 percent of all cancers. In the US alone, more than 1 million Americans will be diagnosed in 2007 with non-melanoma skin cancer, and 59,940 will be diagnosed with melanoma, according to the American Cancer Society. Fortunately, skin cancers (basal cell and squamous cell carcinoma, and malignant melanoma) are rare in children. When melanomas occur, they usually arise from pigmented nevi (moles) that are large (diameter greater than 6 mm), asymmetric, with irregular borders and coloration. Bleeding, itching, and a mass under the skin are other signs of cancerous change. If a child has had radiation treatment for cancer, nevi in the radiated area are at increased risk of becoming cancerous. Skin Cancer Detection System is the system to identify and recognize skin cancer symptoms and diagnose melanoma in early stages. The user can take early prevention of their healthy. Skin Cancer Detection System will help save lots of doctor’s time and could help to diagnose more accurate. It also can easily assess the future development of skin via dialysis today’s age of the skin and put forward the best characteristic skin cancer project to client [1].

2. Image Acquisition

Image acquisition Dermoscopic images are basically digital photographs/images of magnified skin lesion, taken with conventional camera equipped with special lens extension. The lens attached to the dermatoscope acts like a microscope magnifier with its own light source that illuminates the skin surface evenly. There are various types of dermatoscopy equipment, but all of them use the same principle and allow registering skin images with x10 magnification and above. Due to light source integrated into dermatoscope lens, there happens to be problem with skin reflections. To counteract
patterns that are similar in some sense. This goal is very
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similar to what we are attempting to do
denote techniques that are primarily used in exploratory data
image, but can also be combined with pre- and post-
analysis of high-dimensional measurement patterns. In this
(agglomerative) segmentation techniques, we use it here to
become black[7].

Dermatologist can create accurate documentation of gathered
images, opening a path for computer analysis, where images
are processed in order to extract information that can later
used to classify those images[6].

3. Image Preprocessing

Image pre-processing before analysis of any image set can
take place, preprocessing should be performed on all the
images. This process is applied in order to make sure that all
the images are consistent in desired characteristic. When
working with dermoscopic images, pre-processing can
cover number of features like: image illumination
equalization, color range normalization, image scale fitting,
or image resolution normalization. This can be dependent on
defined prerequisites and methods applied in post
processing. An example of elementary operation such as
image normalization is the resolution matching. Assuming
that the image size in pixels is given, and all images are in
the same proportion (e.g. aspect ratio of 4:3), it is easy to
find the images of smallest resolution and then scale the
larger images to match the size of the smallest one. This
operation allows calculating the features like lesion
dimensions, lesion border length and lesions area coverage.
It is possible to normalize the other parameters like color
palette normalization, color saturation normalization,
normalization of color components, and so on. Very
common operation in preprocessing is color components
normalization, known as the histogram equalization. Image
histogram is the distribution of colors values in between
extreme colors used in the palette. Assuming the situation
where the brightest points of the grayscale image are not
white and the darkest points are not black, performing
histogram equalization will redistribute all the colors of the
image in a way that brightest spot of the processed image
will be color and the darkest regions of the image will
become black[7].

4. Segmentation Techniques

A. Threshold Based Segmentation

Histogram thresholding and slicing techniques are used to
segment the image. They may be applied directly to an
image, but can also be combined with pre- and post-
processing techniques.

B. Clustering Techniques

Although clustering is sometimes used as a synonym for
(agglomerative) segmentation techniques, we use it here to
denote techniques that are primarily used in exploratory data
analysis of high-dimensional measurement patterns. In this
context, clustering methods attempt to group together
patterns that are similar in some sense. This goal is very
similar to what we are attempting to do when we segment an
image, and indeed some clustering techniques can readily be
applied for image segmentation.

C. Edge Detection Based

When we know what an object we wish to identify in an
image (approximately) looks like, we can use this knowledge
to locate the object in an image. This approach to
segmentation is called matching [4].

5. Feature Extraction

As per ABCD rule the features which we need to extract
include Asymmetry Index Border Color Index Diameter.

A. Asymmetry Index

Asymmetry Index is computed with the following equation:

\[ AI = \frac{(A1 + A2)}{2Ar} \]

Where, \( A1 \) = Area of non-overlapped region along minor axis
of the lesion \( A2 \) = Area of non-overlapped region along
major axis of the lesion \( Ar \) = Area of lesion Implementation:
Area of lesion\( (Ar) \) can be calculated using bwarea over
the binary image of the segmented region. For calculating non
overlapped area over axis. The segmented region is divided
along the lines passing through centroid of the region Two
separate areas are generated which are then adjusted so that
the areas will be overlapped by flipping one area. Using
XOR over the area will generate the non-overlapped region
whose area is calculated using bwarea function To generate
area along x axis the bisection will be generated using first
Gx pixels and the next Gx pixels along x axis and bisecting
line on y axis. To generate area along y axis the bisection
will be generated using first Gy pixels and the next Gy pixels
along x axis and bisecting line on y axis. After calculating
area of the regions Asymmetry index is calculated using the
specified formula.

B. Border Irregularity

In order to calculate border irregularity, there are different
measures such as: compactness index, fractal index, edge
abruptness.

1) Compact Index:: Compact Index can be determined by
using the following equation:

\[ CI = \frac{(P2L)}{4(AL)} \]

Where, \( PL \) = Perimeter of the Lesion.
\( AL \) = Area of the Lesion.

2) Fractal Dimension: Fractal set is provided by the
"boxcounting" method. It returns two variables whose
differential log ratio provides the fractal dimension as the
mean value along 4-8 index.

3) Edge Variation: Edge variation is calculated using the
following equation \( E1 = \frac{((Max Min) \% + 2)}{100}; \) Where, \( Max \)
and \( min \) are length of major and minor axis. Axis lengths are
calculated using region props function.
C. Color Index

Color index is calculated by converting the input image to hsv image value by checking the presence of the following colors. Length of all the available pixels with given values is divided by total number of pixels. The presence of color is dependent on the value of resultant not equal to zero. For each color present the Color Index is +1.

D. Diameter

The diameter value is said to be 5 if the diameter of lesion is greater than 6mm. For other values the diameter is one less than its actual rounded value. To calculate Diameter the regionprops function is used to get the minor axis length of the lesion region. Resultant value is converted into mm value and the value is assigned to diameter [2].

6. TDS Calculation

Following formula is used

\[
TDS = 1.3A + 0.1B + 0.5C + 0.5D
\]

If the TDS Index is less than 4.75, it is benign (noncancerous) skin lesion. If TDS Index is greater than 4.75 and less than 5.45, it is suspicious case of skin lesion. If TDS Index is greater than 5.45, it is malignant melanoma (cancerous) skin lesion [2][3].

7. Conclusion and Future Work

Incident rates of melanoma skin cancer have been rising since last two decades. So, early, fast and effective detection of skin cancer is paramount importance. If detected at an early stage, skin has one of the highest cure rates, and the most cases, the treatment is quite simple and involves excision of the lesion. Moreover, at an early stage, skin cancer is very economical to treat, while at a late stage, cancerous lesions usually result in near fatal consequences and extremely high costs associated with the necessary treatments.

After all, the best way to lower the risk of melanoma is to limit the exposure to strong sunlight and other source of Ultraviolet light. Take care of all the necessary measures such as: protecting skin with clothing, wearing hat, using sunscreen, staying in the shade (etc.). Moreover, always stay alert about skin and do monthly skin-self exams to reduce the chance of getting any skin cancer which is a risk to human life.

The final output given by the system will help the dermatologist to detect the lesion and its type, accordingly with his knowledge he will examine the patient to draw a final conclusion whether it can be operated or not or any other way to cure it for e.g. using medicines or ointments, etc. Skin cancer detection System will help Dermatologist to diagnose melanoma in early stages. The future scope of the skin cancer detection system is that it can be more accurate and efficient. The ABCD rule of skin cancer detection is the most adopted method of skin cancer in the world. The scope is that the system can be implemented in the stand alone application. The system can be more reliable and robust. The system may provide the Encryption of data and authentication for the users so that there is no unauthorized access of the data of the patient, because if there is unauthorized access is performed on the data then the data integrity may be lost. In future it is more interactive and use friendly for checking the lesion that if it is cancerous or not [9].

References


