Research Article

Melanoma Early Detection and Prevention with Real-Time Automated Skin Lesion using Dual Classifier

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Abstract - Melanoma spreads by metastasis, and therefore it has to be very fatal. A system to prevent this type of skin cancer, is expected and is highly in demand. It is important that excess exposure to radiation from the sun to mark gradually eroded by melanin in the skin. Furthermore, such radiation penetrate into the skin, thereby destroying the melanocytes. Melanomas are asymmetrical and have irregular edges, notched edges or color variations, so that shape, to analyze the color and texture of the skin lesion is important for melanoma detection and prevention. In this work, the components of a portable real-time noninvasive lesion will support analysis system proposed in melanoma prevention and early detection. The first component is a real-time alarm to help users avoid caused by sunlight burns; a new equation, which is the time for the skin to burn introduced thereby calculate. The second component is an automated image analysis including image acquisition, hair-recognition and exclusion, lesion segmentation, feature extraction and classification. The frame is designed in a smart-phone application. The experimental results show that the proposed system is efficient, achieving high classification accuracies.

Keywords: Image Segmentation, Skin Cancer, Melanoma.

1. INTRODUCTION

Melanoma is the most frequent type of skin cancer and its incidence has been rapidly increasing over the last few decades. Nevertheless, it is also the most treatable kind of skin cancer, if diagnosed at an early stage. The clinical diagnosis of melanoma is commonly based on the ABCD rule, an analysis of four parameters (asymmetry, border irregularity, color, and dimension), or the 7-points checklist which is a scoring method for a set of different characteristics depending on color, shape, and texture. Melanoma, a type of skin cancer must be diagnosed at an early stage. Early diagnosis makes treatment effective and life of patient can be saved. Dermoscopy has become important technique in early diagnosis of melanoma. In this technique, oil is applied on skin surface where lesion is present and polarized light is made incident on skin. Then image is acquired with digital camera attached to dermatoscope. This process reveals the morphological structures which
are present in deeper layer of skin. When image acquisition is done using dermatoscope, some artefacts are introduced in image. The hair which is present on skin can be segmented as lesion because of dark pixels being classified as lesion against lighter pixels which will be categorized as skin. So it is necessary to remove these hair pixels from acquired image. In some of the cases, dermatoscope is provided with ruler markings for measurement of diameter of lesion. So these markings will be there in acquired image. The air bubbles and black frame in image can affect the accuracy of segmentation process and further diagnosis of skin cancer. So these artifacts must be removed from dermoscopic image.

In some of the cases, contrast between skin and lesion can be very poor. It is needed to increase the contrast between skin and lesion. Histogram equalization based technique can be used for contrast enhancement. Histogram equalization gives good results for dermoscopic images. This involves remapping in gray levels to produce uniform distribution in input image. Improved contrast between the lesion and skin improves the accuracy of further diagnosis steps. Dermoscopy is a non-invasive diagnosis technique for the in vivo observation of pigmented skin lesions used in dermatology. Dermoscopic images have great potential in the early diagnosis of malignant melanoma, but their interpretation is time consuming and subjective, even for trained dermatologists. Therefore, there is currently a great interest in the development of computer-aided diagnosis systems that can assist the clinical evaluation of dermatologists. The standard approach in automatic dermoscopic image analysis has usually three stages: Image segmentation; Feature extraction and feature selection; Lesion classification. The segmentation stage is one of the most important since it affects the accuracy of the subsequent steps. However, segmentation is difficult because of the great variety of lesion shapes, sizes, and colors along with different skin types and textures. In addition, some lesions have irregular boundaries and in some cases there is a smooth transition between the lesion and the skin. Other difficulties are related to the presence of dark hair covering the lesions and the existence of specular reflections. Some of these difficulties are illustrated. To address this problem, several algorithms have been proposed. They can be broadly classified as thresholding, edge based or region-based methods. An example of thresholding can be found in, where a fusion of global thresholding, adaptive thresholding, and clustering is used. Thresholding methods achieve good results when there is good contrast between the lesion and the skin, thus the corresponding image histogram is bimodal, but usually fails when the modes from the two regions overlap. Edge-based approaches were used in where the segmentation is based on the zero-crossings of the Laplacian-of Gaussian and in several active contour methods like the gradient vector flow (GVF) used in and the geodesic active contour model (GAC) and the geodesic edge tracing described. Edge-based approaches perform poorly when the boundaries are not well defined, for instance when the transition between skin and lesion is smooth. In these situations, the edges have gaps and the contour may leak through them. Another difficulty is the presence of spurious edge points that do not belong to the lesion boundary. They are the result of artifacts such as hair, specular reflections or even irregularities in the skin texture and they may stop the contour preventing it to converge to
the lesion boundary. Region-based approaches have also been used. Some examples include the multiscale region growing described in [1], the modified fuzzy c-means algorithm which is orientation sensitive proposed in [2], the morphological flooding used in [3], a multi resolution Markov random field algorithm and statistical region merging. Region-based approaches have difficulties when the lesion or the skin region are textured or have different colors present, which leads to over segmentation. However, melanoma has been considered as one of the most hazardous types in the sense that it is deadly, and its prevalence has slowly increased with time. Melanoma is a condition or a disorder that affects the melanocyte cells thereby impeding the synthesis of melanin [4]. A skin that has inadequate melanin is exposed to the risk of sunburns as well as harmful ultra-violet rays from the sun [5]. Researchers claim that the disease requires early intervention in order to be able to identify exact symptoms that will make it easy for the clinicians and dermatologists to prevent it. This disorder has been proven to be unpredictable. It is characterized by development of lesions in the skin [6] that vary in shape, size, color and texture. Researchers have suggested that the use of non-invasive methods in diagnosing melanoma requires extensive training unlike the use of naked eye. In other words, for a clinician to be able to analyze and interpret features and patterns derived from dermoscopic images, they must undergo through extensive training[6]. This explains why there is a wide gap between trained and untrained clinicians. Clinicians are often discouraged to use the naked eye as it has previously led to wrong diagnoses of melanoma. In fact, scholars encourage them to embrace routinely the use of portable automated real-time systems since they are deemed to be very effective in prevention and early detection of melanoma. This paper proposes the components of a novel portable (smart phone-based) noninvasive, real-time system to assist in the skin cancer prevention and early detection. A system to prevent this type of skin cancer is being awaited and is highly in-demand [4], as more new cases of melanoma are being diagnosed in each year. In this system we have two major components. The first component is a real-time alert to help users to prevent skin burn caused by sunlight; a novel equation to compute the time for skin to burn is thereby introduced. The second component is an automated image analysis which contains image acquisition, hair detection and exclusion, lesion segmentation, feature extraction, and classification, where the user will be able to capture the images of skin moles and our image processing module will classify under which category the moles fall into; benign, atypical, or melanoma. An alert will be provided to the user to seek medical help if the mole belongs to the atypical or melanoma category.

2. Related Work

An improved border detection in dermoscopy images for density based clustering

Dermoscopy is one of the major imaging modalities used in the diagnosis of melanoma and other pigmented skin lesions. In current practice, dermatologists determine lesion area by manually drawing lesion borders. Therefore, automated assessment tools for dermoscopy images have become an important research field mainly because of inter- and intra-observer variations in human interpretation. One of the most important
steps in dermoscopy image analysis is automated detection of lesion borders. To our knowledge, in our 2010 study we achieved one of the highest accuracy rates in the automated lesion border detection field by using modified density based clustering algorithm. In the previous study, we proposed a novel method which removes redundant computations in well-known spatial density based clustering algorithm, DBSCAN; thus, in turn it speeds up clustering process considerably.

**Digital monitoring by whole body photography and sequential digital dermoscopy detects thinner melanomas.**

Population screening for melanoma remains controversial. There are no studies demonstrating that population screening increases survival. As prognosis of melanoma is directly related to Breslow thickness, a surrogate marker of survival is thickness of melanoma. The development of several self-referred, whole-body photography and sequential digital dermoscopy imaging services reflects the public's concern regarding melanoma. To assess the ability of one of these services to detect melanoma at an early, thin stage. Demographic and histological details from 100 melanomas diagnosed through self-referred whole-body photography and sequential digital dermoscopy imaging service compared to those diagnosed through traditional methods from data held by the New Zealand Cancer Registry. There were 52 invasive and 48 in-situ melanomas: 90% superficial spreading type, 6% lentigo-maligna type and 4% nodular on histology. Forty-eight were diagnosed on first visit; the remainder by serial digital dermoscopy. Thirty-five percent of patients reported having had previous primary melanoma. In 60%, patients had been concerned by the lesion, the rest (40%) detected solely by screening. Patients diagnosed by whole-body photography and sequential digital dermoscopy screening had thinner melanomas compared to the Registry data: 69% <0.75 mm Breslow thickness compared to 52% (p=0.0216); only 1.9% thicker than 3 mm compared to 10.8% (p=0.067). Melanomas detected by self-referred, whole-body photography with sequential digital dermoscopy service are thinner than melanomas detected by traditional diagnostic methods. It remains to be determined whether earlier diagnosis results in improved survival.

**SKINcure: A real time image analysis system to aid in the malignant melanoma prevention and early detection**

Melanoma incidence rates have been increasing for the past three decades. The most important risk factor for Melanoma skin cancer is unprotected exposure to UV radiation. However, early diagnosis of malignant melanoma increases the chances for cure significantly. Therefore a real time image analysis system to aid in the malignant melanoma prevention and early detection is highly in-demand. In this paper, we propose a real time image analysis system to aid in the malignant melanoma prevention and early detection. We present an image recognition technique, where the user will be able to capture skin images of different mole types. Our system will analyze and process the images and alert the user at real-time to seek medical help urgently. This work introduces convenient steps for automating the process of melanoma prevention and detection. Experimental results on a PH2 dermoscopy research database images confirms the efficiency of our system.
Automated skin lesion analysis based on color and shape geometry feature set for melanoma early detection and prevention

Melanoma incidence rates have been increasing for the past three decades. Most people diagnosed with non-melanoma skin cancer have higher chances to cure, but melanoma survival rates are low comparing to other skin cancer types. It is important to note that one in five Americans will develop skin cancer in their lifetime, and on average, one American dies from skin cancer every hour. A system to prevent this type of skin cancer is being awaited and is highly in-demand. Early detection of melanoma is one of the major factors to increase the chance of cure significantly. Malignant melanomas are asymmetrical and have irregular borders with rages and notched edges, so analyzing the shape of the skin lesion is important for melanoma early detection and prevention. In this paper, we introduce an automated skin lesion segmentation and analysis for early detection and prevention based on color and shape geometry. The system further incorporates other feature sets such as color to determine the lesion type. In our proposed system, we used PH2 Dermoscopy image database from Pedro Hispano Hospital for the development of our system and for testing purposes. This image database contains a total of 200 dermoscopy images of lesions, including normal, atypical, and melanoma cases. Our approach of analyzing the shape geometry and the color will be helpful to detect atypical lesions before it grows and becomes a melanoma case.

3. System Design

The database contains a total of 200 dermoscopy images of lesions, including benign, atypical and melanoma cases. Thus, the user will avoid skin burns caused by sun exposure, and thus to prevent skin cancer, our system would calculate the time for the skin to burn and the system to provide a real-time warning to the user to avoid the sunlight and seek shade prevent skin cancer. The system creates a model derived by an equation to calculate the time for the skin that is burning "Time to Burn Skin" (TTSB). This model is derived based on the information of fire frequency and level UV index.

4. Proposed Work

In the proposed system suggests this paper the components of a novel portable (smartphone-based) non-invasive to support real-time system in the skin cancer prevention and early detection. A system to prevent this type of skin cancer, is expected and is highly in demand. The first component is a real-time alarm to help users avoid caused by sunlight burns; a new equation to calculate the time for the skin to burn there is inserted through. The second component is an automated image analysis, including image acquisition, hair detection and exclusion, lesion segmentation, feature extraction and classification, in which the user under which category will classify able to capture images of skin moles and our image processing module the moles fall into; is a typical, or melanoma. A warning to the user are made
available to seek medical help if the mole belongs to the atypical or melanoma category.

The proposed TTSB model can be provided by comparing the calculated TTSB values 2 of the National Weather Service forecast available validated with the information, said TTSB values are calculated our model based on the UV index, skin type, environment variables and SPF Level. The calculated TTSB fall within the scope of the data provided by the National Weather Service available. To the best of my knowledge and belief, this is the first model is proposed that the time-to-skin Burn calculated on the basis of specified UV Index, skin type, environment parameters and SPF, only consider only UV index and skin type. The system is important in the sense that it can be seen that users melanoma at an early stage, allowing in turn significantly increases the chances of recovery. The system provides an image processing method to detect and exclude hair from the dermoscopy images as essential. The result is a clean hair mask that can be used to segment and remove the hair in the picture, it is prepared for further segmentation and analysis.

Advantages:

- This novel framework is able to classify the dermoscopy images into benign, atypical and melanoma with high accuracy.
- The system would calculate the time for skin to burn and the system will deliver a real time alert to the user to avoid the sunlight and seek shade to prevent developing skin cancer.
- This is the first model proposed that calculates the time-to-skin-burn based on the given UV index, skin type, environmental parameters and SPF, unlike that only take into account only UV index and skin type.

5. METHOD

Set Skin Type

To know the types of skin and other characteristics such as sensitivity and inclination, etc., the user can choose to be in this screen. In "Set skin type" screen; the user can check and select them for six skin type options as Fair light skin, light skin, medium light skin, medium dark skin, dark skin and Deep Dark Skin of the Image Gallery view. The picture gallery has sample skin types got that matches for a simple choice with celebrities. The user can also see the selection with the color slider. This screen also shows the skin color and description for heritage and UV sensitivity and tendency to burn information for each selected option.

Dermoscopy Screen

This screen gives the user the ability to manage different profiles. The user can create a new profile by using "+" button at the top right. Each profile will be shown in a series with a small white circle, as is a lot of pictures, there are in this profile are initially this Counting zero.

Image Acquisition

The first phase of our automated lesion analysis system is the image recording. This stage is substantially for the rest of the system; therefore, if the picture is not captured satisfactorily, then the remaining components of the system can not be reached, or the results will not be useful, also by means of a form of image enhancement. To capture high quality images, the iPhone 5S camera, equipped with 8 megapixel and 1.5 pixels is used.

Hair Detection and Exclusion
In this section, an image processing method will exclude the recognition and hair from the dermoscopy images as an essential step also seen. The result is a clean hair mask that can be used to segment and remove the hair in the picture, it is prepared for further segmentation and analysis. To achieve this object, a set of 84 directional filter is used. These filters are constructed by a Gaussian direction is subtracted from an isotropic filter.

Lesion Segmentation
To separate pigmented skin lesions segmentation of the lesion from the background, is an essential process, before to start the feature extraction, to classify the three different types of lesions. The plate structure element is created to obtain the circular nature of the lesion. The radius is set as 11 pixels, so that the large gaps can be filled. Then, the plate structure element is used to conduct a morphological closing operation on the image.

Feature Extraction
In this study, five different feature sets are calculated. These are 2-D fast Fourier transformation (4 parameters), 2-D discrete cosine transform (4 parameters), complexity Feature Set (3 parameters), Color Feature Set (64 parameters) and pigment-network feature Set (5 parameters). In addition to the five feature sets, the following four characteristics are also calculated: Lesion Shape Feature, lesion orientation Property Lesion margin function and lesion intensity pattern property.

Classification
In this context, three types of classifiers are proposed, that is a level classifier (classifier A) and two-stage classifier (classifier B and C).

Performance Analysis
The dermoscopic images were obtained under the same conditions is used at a magnification of 20 ×. This database contains a total of 200 dermoscopic images of lesions, including 80 benign moles, 80 atypical and 40 melanomas. They are 8-bit RGB color images with a resolution of 768 × 560 pixels. No IRB approval has been since the anonymous database and is used for training purposes requires.

6. Results and Discussion
First step in this method is taking the input image as shown in fig.2. Then this image is applied through a filter, where the hair is removed from the image. Both input and filtered image is shown in fig.3. After filtration, image segmentation is applied to separate the lesion from the background is an essential process before starting with the feature extraction which is shown in fig.4. Then the image is segmented by using morphological segmentation technique. The fig.5 shows the output of morphological segmentation. After segmentation features are extracted. Then Lesion Shape Feature, Lesion Orientation Feature, Lesion Margin Feature and Lesion Intensity Pattern Feature as shown in fig.6. In this framework, three types of classifiers are used to classify the image, one level classifier (classifier A) and two level classifiers (classifier B and C) as shown in Fig.7.
Fig 2: Input Image

Fig 3: Filter Image

Fig 4: Image Segmentation

Fig 5: Morphological segmentation of input Image.

Fig 6: Feature Extraction

Fig 7: Image classification
7. CONCLUSION
The proposed system consists of two components. The first component is a real-time alarm to help users avoid the caused by sunlight burns. A novel equation, the time-to-skin burn was introduced to calculate in this component. The second component is an automated image analysis module, where the user to capture in a position that classifies images of skin moles and the image processing module under which category applies to the pier in: benign, atypical or melanoma. A warning to the user are made available to seek medical help if the mole belongs to the atypical or melanoma category. The proposed automated image analysis process included image capture, hair-recognition and exclusion, lesion segmentation, feature extraction and classification. The proposed system used by a prior art for surface microscopy image acquisition, the record on the skin and consistent image quality sharp dermoscopy images ensures a fixed distance. The image processing technology introduced to detect and eliminate the hair from the dermoscopy images, it is prepared for further segmentation and analyzing what. To a satisfactory classification results This system proposes an automated segmentation algorithm and new features. It is able to classify the surface microscopy images in benign, atypical and melanoma with high accuracy.

8. FUTURE WORK
Skin cancer prevention education initiative plans: improving prevention research to identify effective strategies to reduce skin cancer risk. Comprehensive Cancer Control Program will finance selected States with approved skin cancer activities. Promote, distribute, and the implementation of the guidelines for school programs support skin cancer to prevent. Continue to monitor surveillance on sunscreen behavior in the US population. Consider the feasibility of a monograph on the descriptive epidemiology of melanoma in the United States.

REFERENCES


