Melanoma Detection in Early Stage Using Various Techniques: A Review

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Abstract - **Melanoma is considered the most dangerous type of skin cancer. Skin cancer has been increasing year by year. Skin cancer is one of the most dangerous types of cancers, because it's much more likely to spread to other parts of the body if not diagnosed and treated early. About three million people are diagnosed with the disease every year in the United States alone. Early detection of Melanoma skin cancer is very much necessary for the patient for it to be curable. Today's technological advancements can make possible the early detection of skin cancer. In this paper investigating the various techniques for early stage melanoma skin cancer detection.**

Key Words: Melanoma, Skin Cancer, detection

1. INTRODUCTION

Melanoma is a serious type of skin cancer. It starts in skin cells called melanocytes. Melanocytes are what give skin its color. There are 3 main types of skin cancer. Basal cell carcinoma and squamous cell carcinoma are more common. But melanoma is more likely to spread to other parts of the body.

Understanding the Skin

- The skin is the largest organ of the body.
- Skin protects us from heat, sunlight, injury, and infection.

The skin has 3 layers

- The outer layer called the epidermis
- The middle layer called the dermis
- The inner layer called the subcutis

The epidermis is made of flat cells called squamous cells. Round basal cells are under the squamous cells. The lower part of the epidermis also has pigment- producing cells called melanocytes. These cells darken the skin when exposed to the sun. Sweat and sebum reach the skin's surface through tiny openings called pores. The subcutis and the lowest part of the dermis form a network of collagen and fat cells. This layer stores heat and helps protect the body's organs from injury.

When Melanoma Forms

Melanoma can happen anywhere on the skin. Men usually get it on the part of the body between the shoulders and the hips called the trunk. They may also get it on their head or neck. Women usually get it on their arms and lower legs. Sometimes melanoma may occur even on areas of the skin that are never exposed to sunlight. It may even occur in the eye, under a fingernail or toenail, or in the nose and sinuses, or in other parts of the body.

Different types of Melanoma

Melanoma starts when normal melanocytes become cancerous. When cancer cells are on the skin, the cancer is called cutaneous melanoma. Most of what we know about melanoma (its behavior, staging, and treatment) refers to cutaneous melanoma.

- Superficial spreading. This is the most common form, making up about 70% of all cutaneous melanomas. These often grow along the skin for a long time before invading the skin more deeply. They often have irregular shapes and are several shades of brown or other colors, such as black, blue, or red.
- Nodular. These are often black, dome-shaped lesions. They tend to grow vertically, into deeper skin layers.

Acrallentiginous. These are found on the palms of your hands, soles of your feet, under a nail (subungual), or on mucous membranes, such as the mouth, rectum, or vagina (mucosal). This type makes up a larger portion of melanomas in people with naturally darker skin.

- Lentigomaligna. These are common in older people.

They are typically flat and large, spreading widely along the surface of the skin. They often begin as benign lesions on the face or other sun-exposed area.

- Desmoplastic or neurotropic. These melanomas show up as small nodules on the skin, which are nonpigmented (light in color). They can travel and grow along nerves in the skin and can cause fibrous tissue to develop.

- Amelanotic melanoma. These melanomas are often pink or flesh-colored. They are variants of the more common melanomas because they don't make pigment. As a result, they can be mistaken for a pimple or other noncancerous growth.

Keeping an eye on moles

Sometimes groups of melanocytes make moles, also called nevi. Most people have some moles on their bodies. These moles are usually pink, tan, or brown. They can be flat or raised, and are usually round or oval. Most moles are on the chest or the upper part of the body.

Moles don't usually grow or change very much. Moles can fade in older adults. Most moles are not cancer (benign), and do not lead to cancer. Some abnormal moles, called dysplastic nevi, are an increased risk of melanoma. These should be checked regularly by a doctor.

Melanoma growth and spread

If melanoma grows at the site of the original tumor, it tends to grow in one of two ways:

- Radial growth. This means the melanoma spreads horizontally along the top layers of your skin. Most melanomas start growing this way, but some may eventually grow into deeper layers of your skin.

- Vertical growth. This means melanoma grows into deeper layers of skin. This kind of growth is more serious and may spread to other parts of the body. Nodular melanoma grows this way fairly quickly, but most others grow along the top layers of skin first for some time.

Different Types of Melanoma Images

Fig. 1.1 Sample images of Melanoma

2. LITERATURE SURVEY

Accessible Melanoma Detection using Smartphones and Mobile image Analysis

In 2018, Thanh-Toan Do, Tuan Hoang and Victor Pomponiu, demonstrated on smartphone-captured visible light images. The design addresses two major Challenges. First, images acquired using a smartphone under loosely-controlled environmental conditions may be subject to various distortions, and this makes melanoma detection more difficult. Second, processing performed on a smart phone is subject to stringent computation and memory constraints.

In this work, proposed a detection system that is optimized to run entirely on the resource constrained smartphone. System intends to localize the skin lesion by combining a lightweight method for skin detection with a hierarchical segmentation approach using two fast segmentation methods. Moreover, study an extensive set of image features and propose new numerical features to characterize a skin lesion.

Furthermore, proposed an improved feature selection algorithm to determine a small set of discriminative features used by the final lightweight system. In addition, the human-computer interface (HCI) design to understand the usability and acceptance issues of the proposed system. Extensive evaluation on an image dataset provided by National Skin Center - Singapore (117 benign nevi and 67 malignant melanoma) confirms the effectiveness of the proposed system for melanoma detection: 89.09% sensitivity at

specificity _ 90%, Proposed an accessible mobile health-care solution for Melanoma detection, using mobile image analysis. The main characteristics of the proposed system are an efficient hierarchical segmentation scheme suitable for the resource constrained platform, a new set of features which efficiently capture the color variation and border irregularity from the smartphone-captured image, and a new mechanism for selecting a compact set of the most discriminative features. The experimental results based on 184 camera images demonstrate the efficiency of the prototype in accurate segmentation and classification of the skin lesion in camera images.

The Melanoma Skin Cancer Detection and

Classification Using Support Vector Machine

In 2017, Hiam Alquran and Isam Abu Qasmieh Melanoma skin cancer detection at an early stage is crucial for an efficient treatment. Recently, it is well known that, the most dangerous form of skin cancer among the other types of skin cancer is melanoma because it's much more likely to spread to other parts of the body if not diagnosed and treated early. The non-invasive medical computer vision or medical image processing plays increasingly significant role in clinical diagnosis of different diseases. Such techniques provide an automatic image analysis tool for an accurate and fast evaluation of the lesion.

The steps involved in this study are collecting dermoscopy image database, preprocessing, segmentation using thresholding, statistical feature extraction using Gray Level Co-occurrence Matrix (GLCM), Asymmetry, Border, Color, Diameter, (ABCD) etc., feature selection using Principal component analysis (PCA), calculating total Dermoscopy Score and then classification using Support Vector Machine (SVM).

The results show that the achieved classification accuracy is 92.1%. In this study, presented a powerful tool for detection, extraction and classification of skin lesion using PCA and SVM. Concluded that the same accuracy is achieved when the set of the features selected by PCA or the entire set of features are used, but with lower computational complexity. The future work on the skin cancer detection system can be more accurate and efficient where the system can be implemented in the stand-alone mobile application, and, therefore, make the system more reliable and practical

Computer-Aided Detection of Melanoma

Using Geometric Features

In 2016, Rebecca Moussa, Firas Gerges and Christian Salam, Investigate the use of geometric features to differentiate between a benign lesion and a malignant one. The k- Nearest Neighbors (k-NN) machine learning algorithm is used to classify 15 lesions based on their ABD features. An accuracy of 89% was obtained on the testing set.

The results indicate that this technique may be used to detect Melanoma skin cancer. presented a new procedure for Melanoma early stage detection based on geometrical features known as the ABD rule combined with the machine learning k-NN classifier.

The results showed that the features used were able to differentiate between normal and cancerous lesions. Future work includes increasing the size of the dataset and trying our technique on a greater number of images. New features will be extracted and different machine learning algorithms will be investigated in order to further improve the accuracy of this methodology.

Melanoma detection algorithm based on feature fusion

In 2015, Catarina Barata, M. Emre Celebi and Jorge S Marques, investigate which is the best approach to combine different features comparing early and late fusion. Experiments carried on the datasets PH2 (single source) and EDRA (multi source) show that late fusion performs better, leading to classification scores of Sensitivity = 98% and Specificity = 90% (PH2) and Sensitivity = 83% and Specificity = 76% (EDRA). The development of a CAD system for melanoma diagnosis requires the selection of appropriate features as well as the selection of the best strategy to combine them.

In this work we have compared two different strategies for feature fusion early and late fusion. The former is the one used in most CAD systems for melanoma diagnosis, while the later has never been used in this context. Our results have shown that late fusion method seems to be the best approach, with a SE = 98% and SP = 90% on the PH2 and SE = 83% and SP = 76% on the EDRA datasets.

Artificial Neural Network for Skin Cancer

Detection:

In 2014, Sarika Choudhari and Seema Biday demonstrated a neural network system (NN) based method for detection of skin cancer. The different stages of detection involves collection of Dermoscopic images, filtering the images for removing hairs and noises, segmenting the images using Maximum Entropy Threshold, feature extraction using GLCM and c1assification using Artificial Neural Network (ANN). It c1assifies the given data set into cancerous or non-cancerous image.

Melanoma Skin Cancer Detection and Classification Based On Supervised and Unsupervised Learning

In 2013, Ms. H.R Mhaske and Mrs. D A Phalke In this paper early detection and classification of Melanoma skin cancer is done using different classifiers as Neural Network and Support Vector Machine. For Unsupervised learning using k-means algorithm the classification result obtained is 52.63%. In k-means algorithm n data points are divided into k clusters. In case of melanoma skin cancer detection two clusters are formed one cluster is for cancer and another one is for non cancer detection. Support vector machine classifier accuracy is improved than the Back Propagation Neural network and K-Means clustering algorithm. In support vector machine hyperplane is formed which exactly separates data points for different categories and produces high accuracy results.

Automatic Detection of Melanoma Skin

Cancer using Texture Analysis

In 2012, Mariam A Sheha, Amr Sharawy, presented an automated method for melanoma diagnosis applied on a set of dermoscopy images. Features extracted are based on gray level Co-occurrence matrix (GLCM) and Using Multilayer perceptron classifier (MLP) to classify between Melanocytic Nevi and Malignant melanoma. MLP classifier was proposed with two different techniques in training and testing process: Automatic MLP and Traditional MLP.

Results indicated that texture analysis is a useful method for discrimination of melanocytic skin tumors with high accuracy. The first technique, Automatic iteration counter is faster but the second one, Default iteration counter gives a better accuracy, which is 100% for the training set and 92 % for the test set. 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. With main advantage that it is in contrast to other methods in medical image analysis segmentation process is avoided using texture analysis.

At first, Pre- processing adjust all images to a fixed scale [512*512] to support extraction of accurate features; so can obtain clear cut off difference between two types of lesions. It has investigated a classification of dermoscopy images using GLCM features. The texture features obtained from cooccurrence matrix contain 23 sufficient features.

The most significant features were selected using fisher score method. Despite fisher's score simplicity, appears to be a good feature selection method. According to fisher score method 12 features were selected that represent the most significant features. Afterwards, classification process was implemented using MLP classifier that was proposed in two techniques.

The performances of the classifier techniques presented different classification accuracy. The first technique: Automatic MLP proposed 93.4% and 76% for training and testing accuracy respectively. The second technique: Traditional MLP, proposed 100% and 92% for training and testing accuracy respectively. The results indicated that the Traditional MLP yielded the better performance when compared to the first one. In conclusion, this study shows that combination between cooccurrence matrix and ANN is a promising technique for discrimination between malignant melanoma and melanocytic nevi dermoscopy images.

3. CONCLUSION

This paper examined the different stratergies for the melanoma detection. Contrasted with clinical analysis, mix of picture preparing and delicate figuring strategies yielded more precise results to identify melanoma. The procedure of melanoma finding is completed in different stages like preprocessing, division, highlight extraction, post handling and arrangement which utilize advanced systems for getting exact results.

4. REFERENCES

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