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A Comparative Study of Various Techniques for Skin Cancer Detection

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Abstract- Early detection of melanoma skin cancer is critical for effective treatment. In recent times, it is well known that the most hazardous form of skin cancer is melanoma, as it is spread out very fatly in the entire body parts. Therefore, it needs to be treated at its earliest stage. The image processing plays an essential role in the detection and classification of diseases on the images obtained from the digital clinic. In this paper, the existing non invasive techniques are studied which provides an automated image analysis tools and statistics for accurate and rapid assessment of lesions in the images. The performance of several classifiers specifically for the diagnosis of skin lesions is compared and also discussed the corresponding findings. It is found that the artificial intelligence technique performed well when it is integrated with other optimization technique.

Keywords- *Skin Cancer, Lesion, Melanoma, GA, ABCD, ANN, SVM*

1. Introduction

Melanoma is one of the most deadly types of skin cancer, which appear on the skin in the form of moles or marks. Melanoma occurs when melanin-producing cells (melanocytes) have problems, giving them colour. Some of the risk factors for melanoma are fair skin, sunburn history, genetic factors, weakened immune system, tanning beds and excessive UV exposure [1]. The occurrence of melanoma skin cancer has been increasing over the last couple of years. In a 2012 survey conducted in the United States approximately 76,250 numbers of cases of invasive melanoma have been investigated and 9,180 were expired. Australia is one of the countries with the highest incidence of skin cancer in the world. More than 1,890 Australians die each year from skin cancer. Melanoma can penetrate deeper. The most dangerous feature of melanoma is that it can spread widely through the lymphatics and blood vessels. Therefore, early diagnosis of melanoma is a key factor in the prognosis of the disease [2]. As per the survey conducted in 2017, it has been investigated that approximately 9,730 people were estimated to die due to melanoma. From the analysis, it has been observed that Melanoma is 20 times more in Fair person compared to Black skin. Skin disease is mainly diagnosed at the age of 63 or above. However, melanoma is not uncommon even in people under the age of 30. In fact, this is one of the most common cancers among young people, especially young women [3]. To analyze the skin sore and detect it in the initial state a number of non-invasive techniques have been proposed. Each parameter is evaluated, and the ultimate goal is used to predict the type of skin cancers: image acquisition, preprocessing, segmentation, feature extraction, and classification. These techniques have proven to be more effective, less painful and less expensive than medical detection techniques.

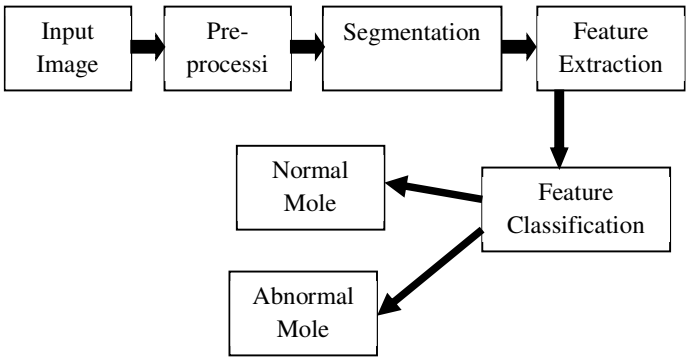

Fig. 1 General Structure of Skin Cancer Detection

In the next section, some of the most recent methods that perform accurate skin cancer detection with a variety of algorithms have been discussed [4]. A general structure of skin cancer detection is shown in fig. 1.

i. Data Acquisition

The data related to skin cancer is collected from different websites.

ii. Pre-processing

It is the initial step, which is used to remove noise from the test as well as dataset images. Pre-processing steps like converting an RGB image into a grayscale image, contrast enhancement, histogram and noise filtering can be employed. Contrast enhancement and histogram modifications are used to obtained images with the same luminance feature and enhance the illumination of images. In skin cancer detection noise detection id used to remove the hair cover on the skin [5]. An example of a pre-processed image is shown in fig. 2.

Fig. 2 Image before and after preprocessing process

iii. Image Segmentation

It is used to separate the Region of Interest (ROI) of the lesion/mole region. This process is performed in different steps: Image thresholding, image filling, image opening. The resultant region is cropped and converted into a grayscale image [6]. The segmented lesion is shown in fig. 3.

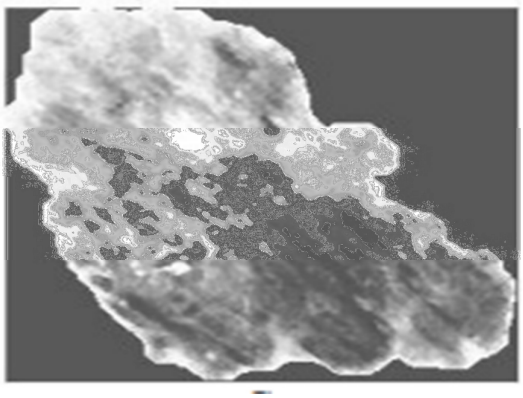

Fig. 3 Segmented image

iv. Image extraction

The pre-defined features are extracted by using different techniques such as Principal Component Analysis (PCA), SIFT, SURF and many more [7].

v. Classification

The classification of disease is performed using supervised as well as unsupervised learning schemes. These schemes worked in two steps: (i) Training and (ii) testing [8].

2. Existing Techniques in Skin Cancer Detection

This section comprises of techniques description that is utilized in the research field of skin cancer detection. A number of techniques are utilized, a few of those are described as follows.

2.1 ABCD rule-based detection

In 1985, to identify melanoma in the premature stages, the group from New York University designed the ABCD approach (asymmetry, Border, colour variegated, diameter > 6mm). It is the easiest technique utilized for the detection of skin cancer.

i. Asymmetry- During this process, ABCD checks the symmetry of lesion. If the value is 0 means lesion is symmetric, if the value is 2, the lesion is asymmetric and considered as cancerous.
ii. Border Irregularity- the border of the lesson is checked. Most of the edges of the cancerous lesion are ragged, gaps or blurred in such cases the values are lies between 0 -8.
iii. The cancerous lesions appear in a number of colours such as white, red, light brown, dark brown, slate blue and black with value ranges from 0 – 6.
iv. Diameter- the diameter of cancerous lesions is more than 6mm and the values range from 0 to 5[9].

2.2 Artificial Neural network

An artificial neural network (ANN) is an integration of a number of nodes connected through links in the same fashion as that of biological neurons in the human brain. The neural network itself is not an algorithm, but a framework for many different machine learning algorithms that work together and handle complex data entry. Such systems "learn" to perform tasks by considering examples, usually without any specific task rules [10]. ANN structure is shown in the fig.4.

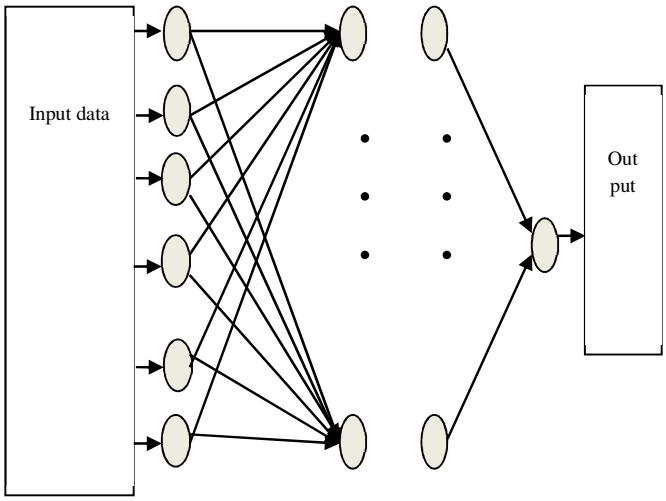

Fig. 4 Structure of ANN

2.3 Support Vector Machine

Support Vector Machine (SVM) is a Discriminant classifier that is usually defined by a separate hyperplane. In other words, given the labeled training data (supervised learning), the algorithm outputs the best hyperplane, which classifies the new example. In a two-dimensional space, this hyperplane is a line that divides the plane into two parts, each of which is located on both sides [11]. The work performed by using the above technique in the field of skin cancer detection is described in table 1.

Table 1: Comparison of existing techniques

References	***Work Steps***	***Methods used***	***Outcomes***
Firmansyah et al. (2017)	The images have been collected digital clinic and testing process has been performed.	ABCD	It is concluded that the accuracy rate of the CMOS camera is high.
Garg et al. (2018)	Three kinds of skin cancer namely; basal cell cancer, squamous cell cancer, and melanoma have been detected. The image testing process goes through different stages: Pre-processing, segmentation, feature extraction using ABCD technique.	ABCD	The accuracy of up to 91.6 % has been achieved.
Monisha et al. (2018)	The work is performed into the following steps; Image acquisition, segmentation feature extraction and classification	ABCD with Backpropagation Neural network	The accuracy of up to 95% has been obtained.
Salem et al. (2018)	The data is collected through the tradition method (Dermoscopy) Two techniques have been used to classify lesion images into benign or malignant. In the initial stage, Image processing has been used for the extraction of asymmetry, border and irregularity. In the second stage genetic algorithm has been used for the classification of the lesion.	Genetic Algorithm (GA)	The accuracy of up to 76.17% has been analyzed

Roffman et al. (2018)	The neural network has been trained on 13 various factors such as gender, age, BMI, diabetic status, smoking status, emphysema, asthma, race, Hispanic ethnicity, hypertension, heart diseases, vigorous exercise habits, and history of stroke	Neural network	The training and testing accuracy of about 80.05 % and 80.09 % have been measured.
Zhao et al. (2018)	SVM is used as a classification algorithm with four different kernels named as a linear, radial basis, sigmoid and polynomial. The working process of the designed model consists of a feature selection stage, SVM kernel selection, classification and prediction of disease (cancer or healthy).	SVM	The accuracy of up to 91.2 % has been achieved.

3. Comparative analysis of existing techniques

The work that has been performed by different authors using distinct classification and optimization schemes is discussed in table 1. The classification accuracy measured by these researchers is listed in table 2 along with the graphical representation as shown in fig. 5.

Table 2: Accuracy of existing Skin detection Schemes

Techniques Used	*Classification Accuracy*
ABCD	91.6
ABCD with Backpropagation Neural network	95
Genetic Algorithm	76.17
Neural network	80.09
SVM	91.2

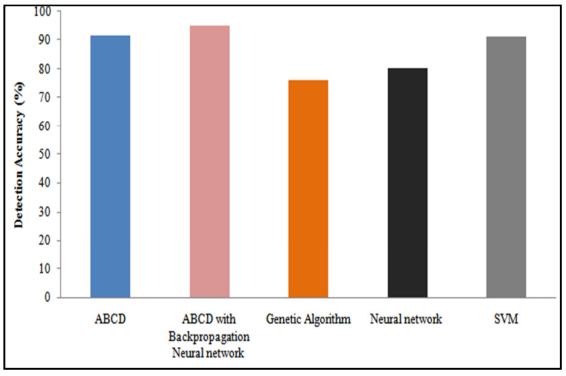

Fig. 5 Comparison of Detection Accuracy

Fig. 5, represents the graphical representation of the accuracy rate measured in percentage for different techniques as discussed in section II. It is clear that the detection accuracy of the Skin cancer detection system that utilized the ABCD approach with Backpropagation Neural network is high about (95 %) compared to other existing schemes.

4. Conclusion

In this paper, the various non-invasive techniques for classification and detection of skin cancer have been studied. The detection process of melanoma is carried out in different stages such as pre-processing, segmentation, feature extraction and classification. The investigation focused on a number of strategies such as GA, SVM, ANN, and ABCD rules. From the analysis, it has been investigated that the ABCD approach with Backpropagation Neural network has performed well compared to other mentioned schemes with an accuracy rate of about 95 %.

In future experiments, optimization algorithm can be used such as GA with multiclass classification scheme like ANN to enhance the performance of the skin cancer detection and classification system.

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