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Machine Learning-Based Melanoma Skin Cancer Detection

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Abstract Skin cancer is the most commonprevalent and serious form of cancer in humans, with melanoma being a particularly deadly type. Early detection of melanoma is crucial for successful treatment. However, the standard biopsy method for diagnosis is painful and time-consuming. To address this issue, a computer-aided detection system using methods for Support Vector Machine (SVM) and image processing has been developed for the detection of melanoma at an early stage. This involves taking an affected skin image and subjecting it to pre-processing techniques, segmentation combining thresholding andmorphological techniques, and capturing key aspects of texture, color, and form, including using the GLCM (Gray Level Co-occurrence Matrix) texturing approach feature extraction. These extracted features are then fed into the SVM classifier, which categorizes the image as Melanomas may be cancerous or benign. By combining and applying the shape, color, and GLCM features, ahigh level classifier accuracy rate 83% is attained.

Keywords - SVM, segmentation, GLCM, and melanoma

I. INTRODUCTION

The skin is the body's most crucial organ, serving to safeguard the internal organs, bones, and muscles underneath from injury. One of the most significant roles of the skin is protecting the body from harmful UV Fair-skinned people are more vulnerable to skin damage from UV radiation than dark-skinned people. radiation from the sun, which can damage DNA in skin cells and lead to skin-related diseases and skin cancers. Skin cells contain melanin, which helps protect the skin from UV radiation, but fair-skinned individuals are more susceptible to skin damage from UV radiation than those with dark skin due to lower melanin levels.

As a result, fair-skinned individuals are more frequently diagnosed with melanoma, the deadliest type of skin cancer, which can be classified into malignant and benign forms. The prevalence of malignant melanoma is just 4% of the population., it is responsible for 75% of melanoma cancer deaths. Early detection of melanoma is critical for successful treatment and can save lives. However, if melanoma is not detected early, it can penetrate deep into the skin, making treatment more difficult. Melanocytes are present in the body and primary cause of melanoma. The biopsy technique is the official procedure for detecting skin cancer, which involves extracting a piece of tissue from the body and sending it to a laboratory for testing. This process is complex, painful, and time-consuming, and carries a risk of spreading the disease to other parts of the body.

Researchers have proposed various detection techniques for melanoma, including segmentation, feature extraction, classification, and pre-processing are the four primary steps. Segmentation is used to isolate the lesion from the skin to obtain the region of interest, while the GLCM methodology has been widely used for feature extraction due to its simplicity and effectiveness.

II. LITERATURE REVIEW

Skin cells body from harmful UV radiation from the sun, which can damage DNA in skin cells and lead to skin-related diseases and skin cancers. Skin cells contain melanin, which helps protect the skin from UV Fair-skinned people are more vulnerable to skin damage from UV radiation than dark-skinned people. radiation than those with dark skin due to lower melanin levels. As a result, fair-skinned individuals are more frequently diagnosed with melanoma, the deadliest type of skin cancer, which can be classified into malignant and benign forms. Although The prevalence of malignant melanoma is just 4% of the population.

In the area of detecting melanoma skin cancer, numerous researchers were active. They applied a wide range of computer vision algorithms, such as image processing, segmentation, feature extraction, and classification. These strategies are applied in other research publications as well. Support Vector Machine (SVM) technique is the foundation of the diagnosing methodology in [2] for the categorization goal. The median filter is employed to reduce unwanted noise. and contrast enhancement is employed to produce images of higher quality. Then, maximum entropy thresholding is used to segment the data. The study of texture images for feature extraction employs the GLCM approach. The segmentation in [5] is done using the Grab Cut method, and the features are retrieved using the ABCDE rule: Asymmetries, Border irregularities, varying in size). SVM is used to classify these extracted features as malignant or non-cancerous moles. 200 photos were used in assessment studies in this paper (100 of melanoma and 100 of benign). According to the results of the suggested system in [6], SVM with a linear kernel provides the best accuracy. Segmentation is carried out using the Otsu thresholding technique. The edges of the output image become erratic when Otsu thresholding is complete. Because of this, a morphological filter is used to soften the edges. The given skin image will be used to extract colour, perimeter, area, irregularity, and texture attributes in this system. SVM is utilised for classification in this instance as well. Two techniques are presented in [7] for separating the lesion component from The ABCD rule aids with feature extraction. The TDS value is calculated using the retrieved feature values.

Dermoscopy images are examined for With the calculated TDS value, one may determine whether melanoma is present. The ABCD rule is the foundation for TDS calculation. The TDS value establishes the Melanoma. [8] uses the colour and texture characteristics of skin photographs to extract the attributes of the proposed system. The texture attribute is handled using the GLCM approach. On the basis of extracted colour and texture features, the Out of all the submitted dermoscopic pictures, the SVM classifier is chosen to be used to identify melanoma images. The performance of the suggested approach for the identification of melanoma is assessed using the PH2 dataset.

In [9], The maximum entropy threshold approach is then used to segment the preprocessed image. Following the feature extraction process using GLCM algorithms on the segmented image. Then, Artificial Neural Network (ANN) is employed in order to classify data. In [10], picture enlargement, contrast, and brightness adjustment is described as the proposed system preprocessing. Moreover, image segmentation employs edge detection and background subtraction. The features are analysed using the ABCD rule. Also, they used an ANN with a propagation technique to perform classification.

The majority of the scholars who worked on this study suggested several detecting methods. The four fundamental steps of the common detection approach are pre-processing, segmentation, feature extraction, and classification. which is used to identify melanoma, a kind of skin cancer [3]. To obtain the region of interest, the lesion component is separated from the skin during the segmentation procedure [4]. Due to its efficiency and ease of use, the GLCM methodology has been heavily included into the process used by several computerised melanoma detection systems for feature extraction. This computer-based analysis will shorten diagnosis times and improve accuracy.

Given the intricacy of dermatological conditions, it is particularly challenging to make a rapid, reliable, precise diagnosis, particularly in poor and developed countries with limited healthcare resources. Also, the likelihood of suffering significant consequences is decreased by early disease identification. Several types of melanoma skin illnesses have been triggered by a number of pertinent environmental variables [1]. In this study, we developed a novel method for melanoma diagnosis at the feature extraction stage. We strive to classify melanoma with fairly high accuracy.

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III. DESIGN AND ANALYSIS OF SYSTEMS

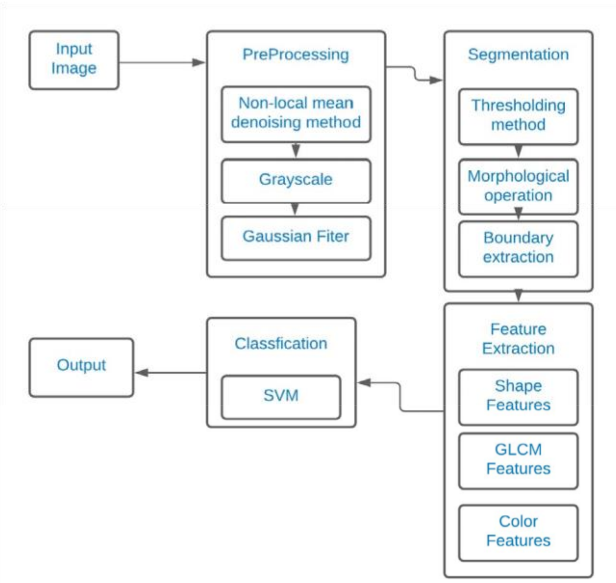

Figure 1. Methodology

A. *Input Images*

The ISIC online dataset is where the skin photos for this investigation were gathered. Images for skin cancer are available in this internet archive. An accurate system for melanoma detection and a decrease in melanoma-related fatalities were the goals of the ISIC melanoma detection-based initiative. Up to 23,000 photos can be found in this ISIC dataset. We gathered 600 photos for this study, trained them, and then tested them.

B. *pre-processing of images*

The primary goal of picture preprocessing is to improve the image quality while preparing the dermoscopy images for subsequent processing by removing undesirable background elements. The high-frequency elements and sounds were eliminated using the filters.

The skin image preprocessing stages were as follows:

(1) Noise and hair removal method;
(2) Greyscale from RGB picture conversion.
(3) Using a Gaussian filter to smooth an image.

1) Noise and hair removal techniques

The main objective of this technique is to eliminate unwanted noise and hair from skin image. The primary issue here is investigation is determining which features are real and which are brought on by unwanted noise. Pixel value fluctuations caused by noise. In this work, we apply the Non-local Mean Denoising method to remove unfavourable skin components photos.

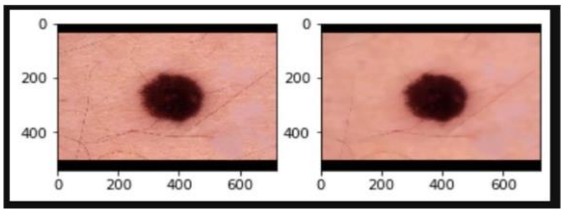

Figure 2. Noise removed

3) compare an input image to a denoised image and show the differences.

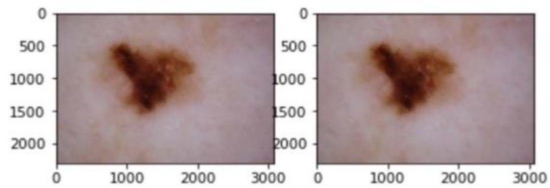

Figure 3. Noise removed

2)Conversion of RGB to Grayscale

Brightness is the sole information contained in a grayscale picture. Each pixel value in a grayscale image corresponds to a certain amount or quantity of light. The brightness gradient can be seen in a grayscale picture. A grayscale picture just measures light intensity. Our suggested method turns colour photographs into grayscale since grayscale photos are quicker and simpler to process than coloured images. Prior to turning the noise-free images to grayscale, we first remove hair and noise. Figure 4 depicts the image in grayscale.

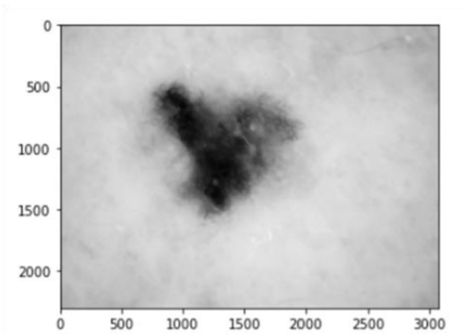

Figure 4. Grayscale

Using a Gaussian filter to retouch the image
Gaussian smoothing distorts images. How much smoothing is done is determined by the Gaussian's standard deviation. is done. The result of the Gaussian filter is an average of each pixel's neighbourhood that is more heavily weighted towards the value of the

IV. CONCLUSION AND RESULTS

Our suggested diagnosis system is quite effective when compared to the formal biopsy method. In this study, the melanoma detection procedure is less expensive and takes less time. For the purpose of detecting skin cancer, the system combines approaches for image processing and machine learning. The SVM technique was used to assess the skin lesion disease's accuracy in the image. The SVM algorithm was applied to improve the efficacy and precision of the melanoma detection process. Initially, shape features are extracted in the suggested system. The form characteristics that are retrieved in this case are diameter, area, perimeter, abnormality, irregularity, and circularity. There are five aspects of an image that were chosen at randomin Table 1.

TABLE 1. SHAPE FEATURE EXTRACTION RESULTS

Image ID	Area	Perimeter	Diameter	Abnorma lity	Irregula rity	Circula rity
1	24958 2.0	2115.02	563.73	1482.95	1.43	17.92
2	23053. 0	1308.95	344.21	893.34	1.47	18.41
3	26808 8.5	2457.6 9	4532.62	1155.51	1.58	19.88
4	17574 8.0	6551.6 3	473.08 3	1232.90	1.45	17.26
5	73415 9.0	54577.7 0	824.69	2047.91	1.60	20.11

Following extraction, the shape characteristics are passed to the SVM for classification of the images using various test data sizes. Performance of the ratio of the different train to the test using shape characteristics is stated in Table 2.

TABLE 2. ACCURACY WITH SHAPE FEATURES FOR DIFFERENT TRAIN TO TEST RATIO

Train to Test ratio	Accuracy
50% to 40%	60%
50% to 35%	59%
60% to 25%	67%
70% to 20%	60%
80% to 10%	69%

After that, we exclusively use GLCM characteristics to classify skin photos. The characteristics chosen as GLCM features include contrast, correlation, inverse different moments, and entropy.
Five randomly selected photos with characteristics are presented intable 3.

TABLE 3 GLCM FEATURE EXTRACTION RESULTS

Image ID	Contrast	Corelation	Inv.dif.moment	Entropy
1	5.3229	0.9946	0.5962	8.8114
2	6.7088	5.7088	0.5050	9.4623
3	5.7545	0.9950	0.5216	9.1870
4	4.4357	0.9945	0.5318	9.0827
5	33.3354	0.9844	0.3676	10.2662

V. CONCLUSION AND FUTURE WORK

This work aims to create a reliable approach for identifying melanoma skin cancer so that it may be quickly determined whether benign or malignant melanoma is present in the supplied picture. When the GLCM methodology with colour and shape features are coupled for the feature extraction, the suggested system has a high accuracy of 83%. Because it is a tried-and-true, painless approach, it is more effective and comfortable for patients and doctors than biopsy. We were unable to find any darkskinned photos in the public data repositories to use for implementation. However, the dark skins are essential for further studies and experiments on the matter.

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