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Automatic Skin Cancer Detection using GLCM & Support Vector Machine in Digital Image Processing

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***Abstract*—** Skin malignancy - an anomalous development of skin cells - frequently creates on uncovered skin. This basic type of malignant growth ordinarily happens on the skin without exposure of sunlight. There are three primary sorts of skin malignancy - basal cell carcinoma, squamous cell carcinoma and melanoma. It can be minimized the risk of skin disease by restricting or forestalling ultraviolet (UV) radiation. Testing the skin for dubious changes can help identify skin malignancy at a beginning phase. Automatic detection of skin cancer is a very effective tool, especially in the absence of specialists. Image processing has been practiced in various fields over the past decades, allowing to improve the interpretation, representation, and processing information of an image. Here the proposed system is based on Grey Level Co-occurrence Matrices (GLCM) and Support Vector Machine (SVM). A GLCM is a histogram of co-occurring greyscale values at a given counterbalance over an image. SVM kernel method has been used to classify the skin lesion and identify the type of skin cancer. System achieved 96.36 % of accuracy with minimal false alarm rate.

***Keywords*—** Skin Cancer, GLCM, Basal Cell Carcinoma, Squamous Cell Carcinoma, Melanoma, Segmentation, Support Vector Machine.

I. INTRODUCTION

Skin disease is one of the most well-known tumors in people. It tends to be delegated non-melanoma and melanoma. Despite the fact that melanoma is more uncommon than non-melanoma, it is the most widely recognized reason for death. Accordingly, Therefore, it is necessary to develop computer-aided diagnosis (CAD) aimed at identifying such lesions and initiating early diagnosis to increase the patient's risk of survival [1]. Certain techniques in the field of DIP have been proposed and computational techniques utilizing calculations or frameworks to tackle clinical issues. Automatic skin malignancy detection is one of the major testing task in clinical image processing. Automatic analysis framework deals with two dependent phases – the first distinguish skin irregularities and second identifies the benign or malignant melanoma [2]. The SVM classifier is applied on the statistical texture features to predict the skin cancer malignancy. Each skin image in test set is classified by comparing it against the skin images in the training set. The training set comprises of both typical and malignancy skin images and skin infection images. Kernel method is preferably used to classifies the polynomial data or those data that cannot be classified by linear hyperplane. Skin impaired cells have distinct and irregular in shape and template matching is not a good idea for classification and identification.

Figure 1. Skin Cancer [3]

Fig. 1 shows the impairments over skin that gradually increases day by day. SVM classifier transforming the normal cells and impaired cells in different clusters by using hyperplane. This system uses non-linear classifications that may also called kernel method. SVM is considered as best classifier especially for medical imaging diagnosis.

II. RELATED WORK

Various researches have been done in the field of automatic skin cancer detection. System accuracy is often important because proper identification can simulate a system well with proper classification and identification. Farzam Kharaji Nezhadian et al. [4] proposed a system that is primarily based on preferred segmentation technique wherein most cancers affected pores and skin location may be extracted and later classify the most cancers the usage of 2-D discrete wavelet transform. This paper makes use of SVM in addition to shadeation texture popularity for higher class. But transformation version is susceptible that resulted sharpen the image that looses the sensitivity of the disease. The motive of this take a look at became to diagnose benign and malignant melanomas. The maximum critical step is phase photo with excessive accuracy. Amulya P M et al. [5] proposed a system which is likewise primarily based on SVM Classifier. The system relies upon the training samples and system iterations. In this study, we've investigated diverse techniques for cancer classification and detection. The method of cancer detection is evaluated in diverse ranges together with preprocessing, division, characteristic extraction, post handling, and preparations that use superior structures and software program to attain correct results. Prachya Bumbrungkun et al. [6] proposed a system that is primarily based on SVM classifier and snake model. This paper has been reported the causes of death in Thailand due to skin cancer. So, primarily based on SVM test; it allows to remember the template that evaluate with the enter image. It has been taken into consideration that input skin cancer image may have curves, circles, rectangles and ellipse. It additionally makes use of snake model that is an aspect detection approach that has been used for extracting the rims of the functions that later evaluate with the templates. However the undesirable vicinity may be removed and labeled that doesn't have an effect on the precise recognition rate. But snake version isn't always a great model for extracting edges from skin feature templates. Soniya Mane et al. [7] proposed a system that's primarily based on preprocessing and classification strategies consisting of segmentation through thersholding and SVM classifier resp.

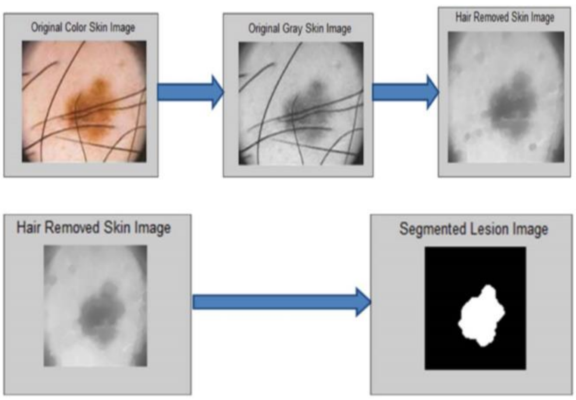

Figure 2. Pre-processing [7]

Clustering is called the method of grouping of comparable statistics objects together, while the other cells with the different clusters are as multiple as possible. This paper represents an efficient method to detect skin cancer. The system makes use of computer aided diagnosis to stumble on the skin cancers. Detecting skin cancers manually isn't only exhausting, however additionally a time-ingesting task. Noel B. Linsangan et al. [8] proposed a framework which depends on k-Nearest Neighbors. The subsequent framework is a skin wound analyzer utilizing picture handling innovation in a solitary board computer. Through the mathematical highlights of the skin injury, the scientist had the option to group speculated skin disease tests from threatening, kind, and obscure. The framework had the option to perform tests to decide its precision. It was discovered that there are images that are not prepared by the framework and generally give blunders alluding to the extraction of highlights in the image.

III. PROBLEM IDENTIFICATION

Most of the system uses machine learning methods to train the system with various samples. But a large dataset can consume the large amount of memory that increases the execution time where it is very important to communicate as earlier as possible with high level of accuracy. This paper describes the method of detecting melanoma using image processing tools. Efficient equipment support Quantitative medical diagnosis is computer analysis and image processing. So the feature extraction step is enough depending on the area where the disease is detected. So, appropriate segmentation algorithm is required which can be effectively Find skin melanoma pixels in the information image. Pre-processing approach employed in detection of dormoscopic images is included at various stages, filtering images using sluggish razor filtering for removal Hair and air bubbles in the image, converted to gray scale, split images using noise filtering, threshold, hybrid threshold, repetition threshold, multilevel threshold and automatic threshold. In future a system can be developed that may have good accuracy rate with less false alarm or recognition that acquire less execution time. Md. Zahid Hasan et al. [9] proposed a system that uses ANN (Artificial Neural Network) for classifying skin disease from infected area. System uses machine learning methodology for training datasets with various samples of skin diseases. System also erodes the non cancerous area on the basis of skin color and highlights the cancerous part. But train a system on the basis of supervised sample is not enough capable to dealing with irregular or undefined cancerous disease. Neural network is limited with samples and hard to predict correct decision on the basis of that. In machine learning a best classification method can classify the cancerous part effectively. System achieved 95 % of accuracy which could be bit higher. In this research, the effects of dimensionality are investigated using the Rough set on skin cancer decision support systems with multiple classifications such as Artificial Neural Network (ANN), Support Vector Machine (SVM) and Random Forest (RF). Results for the proposed model demonstrated that ANN is working with the aim of improving through a limited number of three types of at-risk skin cancer (common nevus, atypical nevus, and melanoma) datasets.

IV. PROPOSED WORK & IMPLEMENTATION

Here the proposed work is able to recognize various types of skin cancer with high level of accuracy with support vector machine. System will be capable to classify the cancerous area by determining its patterns or textures; not only on the basis of color and iterations will help to lead more accuracy as compare to the previous one. System can deal with unstructured data or non linear data points using kernel tricks. Skin cancer detection using SVM is basically defined as a process of detecting the presence of cancer cell in the image. SVM is machine learning technique, mainly used for classification and regression analysis.

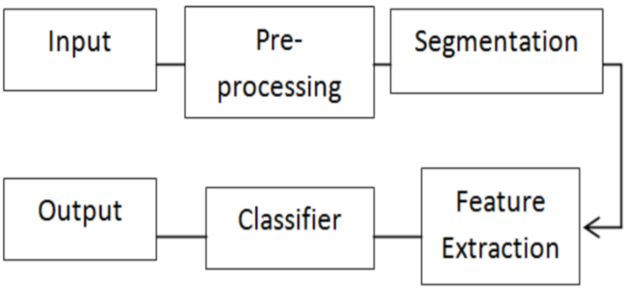

Figure 3. Block Diagram

Fig. 4 shows the graphical user interface for proposed work where an input skin image is to be browsed and process the image for obtaining impaired cells.

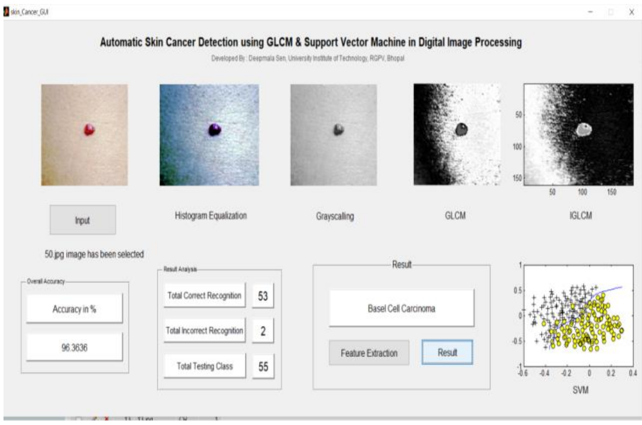

Figure 4. Proposed Work GUI

Pre-processing aims to improve image data that reduces and increases unwanted distortions some images are important for the front image processing. The objective of image enhancement is to process an image to increase visibility of feature of interest. Segmentation is process of removing region of interest from given image. Region of interest containing each pixel similar attributes. Here we are using maximum entropy thresholding for segmentation. The classifier is used to classify the image of cancer other skin diseases. Support vector for simplicity machine classifiers are used here. Takes set of SVM predicts images and for each input image which of the two categories of cancer and non-cancer. SVM aims to create hyper plane that separates the two squares maximum difference between them.

A. Histogram Equalization

Histogram equalization is the first pre-processing model that has been used for enhancement. It highlighted the impairments and segmenting the background region that may affect the precision.

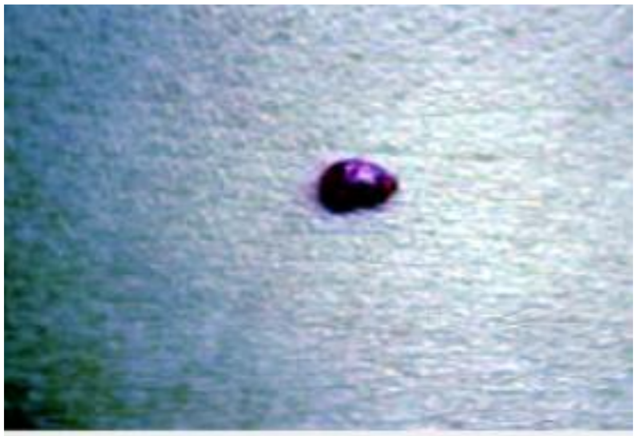

Figure 5. Histogram Equalization of Inut Skin Cancer Image

B. GLCM

A statistical technique for inspecting surface that considers the spatial relationship of pixels is the dark level co-event framework (GLCM), otherwise called the dim level spatial reliance lattice.

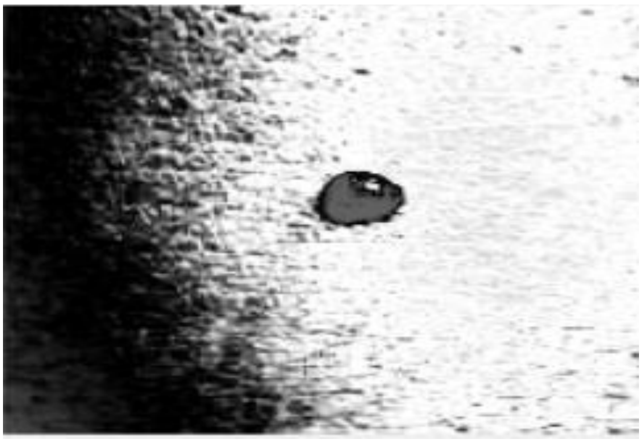

Figure 6. GLCM of Input Skin Cancer Image

The GLCM capacities describe the surface of a picture by figuring how regularly matches of pixel with explicit qualities and in a predefined spatial relationship happen in a picture, making a GLCM, and afterward extricating statistical measures from this lattice.

C. Support Vector Machine

A non linear transformation of the support vectors can be used and classified. The proposed classification calculates the CDR value of the respected image and the presence / absence of the skin cancer. The properties of the images are collected using PCA (Principal Component Analysis). The accuracy and efficiency of the proposed classification are compared with the methods used by morphology based image classification with fused method and support vector machines.

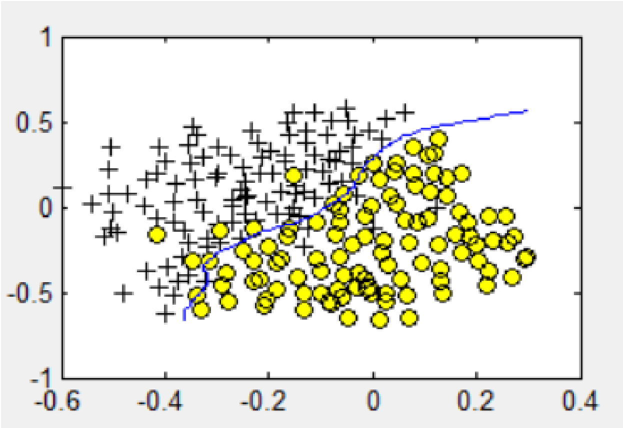

Figure 7. Support Vector Machine Classification of Input Skin Cancer Image

D. Flow Chart

First of all, system attains a skin image and later pre-processes it for better visibility such as histogram equalization. Once the enhancement has been completed then GLCM is to be multiplied with enhanced matrix separately. Then SVM classifies the normal cells and the impaired ones. Then entropy of the extracted area will be calculated and if it is greater than the threshold value then it is considered as cancer otherwise a healthy skin is declared.

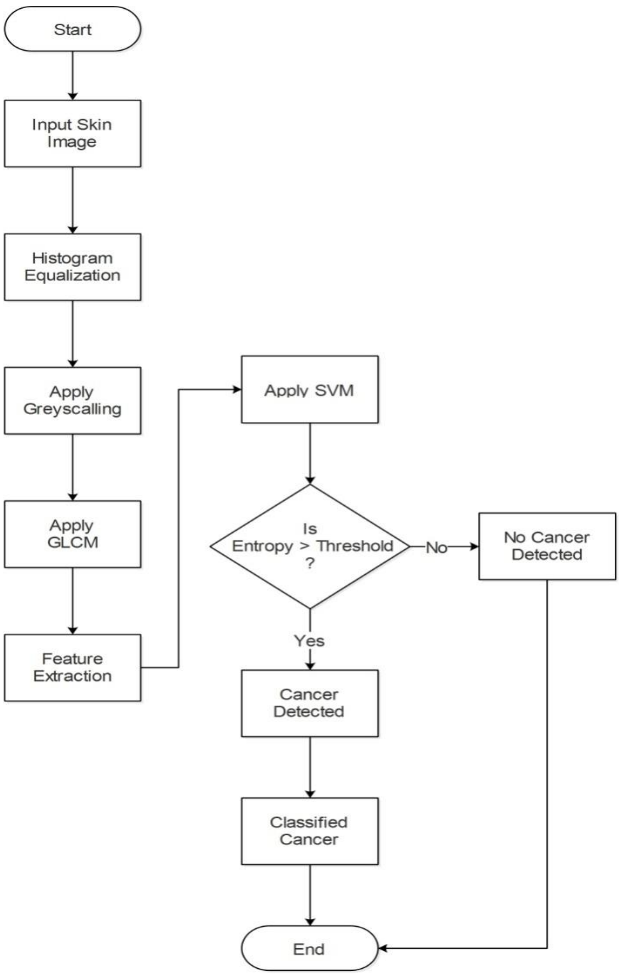

Figure 8. Flow Chart of Proposed Work

E. GLCM & SVM Classification Algorithm

Input: I ← Input Skin Image as 2D matrix
Output: O ← Classifier

Step 1: Input 2-D image as an array
Step 2: Convert RGB skin image to grayscale image
Step 3: Apply histogram equalization

$$CDF_x(i) = \sum_j^0 P_x(j)$$

where the CDF is cumulative distribution function, x is considered as grayscale image, i is gray level and P is the probability

Step 4: Apply GLCM

$$\mu = \sum_{i,j=0}^{N-1} iP_{ij}$$

P_{ij} is an element of the normalized symmetrical GLCM, N is the number of graylevels and is the GLCM mean

Step 5: Compute, μ^{-1} for extracting inverse matrix for clustering.

Step 6: Apply SVM by defining data points

$(x_n, y_n) \rightarrow (x_1, y_1).....(x_n, y_n)$

Step 7: Separate the data points by hyperplane

$\vec{w}.\vec{x}$ - b = 1
$\vec{w}.\vec{x}$ - b = 0
$\vec{w}.\vec{x}$ - b = -1
where $\vec{w}$ is the normal vector of the hyperplane

Step 8: Plotting Data
Step 9: Compute Entropy
Step 10: if Entropy > T_r **then**
Cancer Detected;
else
No Cancer Detected;
end else
end if
Step 11: Classify Cancer
Step 12: End

V. RESULTS AND DISCUSSION

The simulation studies involve the various trails with distinct skin cancer images. There are total number of 55 trails where 53 trails recorded as correct recognition and 2 as incorrect that may includes true positive, true negative, false positive and false negative. True positive means that there are certain trails that positively detected which returns correct recognition and few images that may contain cancer but system is not able to detect; that entertained in the category of true negative. Similarly as false negative where image is detected as cancerous but actual there is no cancer in the image, whereas false positive means having no cancer image rejected positively. So, by observing all these datasets, the perceived accuracy is 96.36 %.

Table 1. Result Analysis

Traits	Outcomes	Result (Accuracy)
Correct Recognition (CR)	53	96.36%
Incorrect Recognition (IR)	2	0.036%
Total Testing Class (TTC)	55	96.36 % (Overall Accuracy)

Table 2. Result Comparison

	Classification	Method	Accuracy in %
Md. Zahid Hasan [11]	Atypical Nevus, Melanoma	ANN	95.00
Proposed*	Actinic Keratosis, Basel Cell Carcinoma, Cherry Nevus, Dermatofibroma, Melanocytic Nevus and Melanoma	GLCM & SVM	96.36

VI. CONCLUSION AND FUTURE SCOPE

In order to diagnose the skin cancer, there are various testing methods available but there are lots of deficiencies in these models. There should be an alternative diagnostic system that can effectively work for advance stages. This paper is intended to achieve a method through which an automatic diagnosis system can be implemented for skin cancer that resulted better accuracy as compare to the earlier proposed systems. This paper uses GLCM as well as SVM classifier for better classification and segmentation. System also classifies the type of skin cancer that helps medical professionals. The recorded accuracy is 96.36% which is higher than the earlier ones. As per the future scope of the system, this system can be implemented with distinct approaches that may reduce processing time and enhances the accuracy of the system by degrading the error rate. In the field of medical, it is very important to detect any of the disease with ideal accuracy where there is no false recognition should be entertained.

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