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SKIN LESION CLASSIFICATION USING 3D RECONSTRUCTION

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Abstract - *skin cancers are mainly two types, melanoma and nonmelanoma. For cancer detection different methods are used. A 3D reconstruction method developed for detecting early skin cancer melanoma on 2016. Here some modifications are used for the 3d reconstruction skin lesion classification. This Paper presents two classification methods for the early detection of skin lesion cancer mainly melanoma skin cancer. First classifier based feed forward ANN and second classifier based on SVM. The combination of ANN and SVM classifiers increases the system performance. A classification with a success of 92% has been obtained by using the combination of two classifier.*

Key Words: **3D Reconstruction, ANN Classifier, SVM Classifier**

1. INTRODUCTION

A skin lesion is an abnormal growth or an area of the skin that does not resemble the skin surrounding it. Skin lesions can be grouped in to Primary and secondary skin lesions .Primary skin lesions are variation in color and texture that may be present at birth or that may be acquired during a person's lifetime. Secondary lesions are the area of the skin that results from primary skin lesions. The overwhelming majority of skin lesions don't seem to be cancerous. However doctors will determine whether particular lesions are cancerous or not based on the observations and the result of a biopsy. The early detection of skin cancer is a key to successful treatment. Skin cancers are broadly classified in to melanoma and non melanoma.

The world health organization reports a rapid increase of skin cancer cases. About two to three million cases of non-melanoma cancer and 132,000 melanoma cancers are reported annually worldwide. The early detection decreases the treatment cost.When considering various types of skin cancers and dependency skill level of dermatologist accurate diagnosis of melanoma is still a problem. The problem addressed during this is the way to analyze a given digital dermoscopic image for identification cancerous lesions particularly malignant melanoma.

Computerized system primarily constitutes of 5 components. (1)image acquisition (2)segmentation (3)feature extraction(4)feature selection(5)decision making. Considering the depth and 3D geometry of the skin lesion is critical to achieve the accurate diagnosis. A non invasive computerized dermoscopy system to aid diagnosis of skin lesions is proposed in this paper. Special emphasis is laid to aid diagnosis of in-situ melanoma. A Gradient vector flow model used for segmentation of the 2D dermoscopic skin lesion images. A depth map is derived from the 2D dermoscopic image for reconstruct the 3D image. The depth map construction is adopted and the depth map data is fit to the 2D surface to achieve 3D skin lesion reconstruction. The 3D skin lesion is represented as structure tensors. Using the 2D skin lesion data color, texture and 2D shape features are extracted. The 3D reconstructed skin lesion data is used to obtain the 3D shape features. The 3D shape features encompass the relative depth features estimated. After feature extraction and selection SVM and ANN classifier is used for classification.

2. REVIEW

Identification of the skin lesion or region of interest in dermoscopic images is achieved through segmentation procedures. Vogt, M.; Ermert, Helmut[32] proposed Gradient vector flow method for segmentation. Which has been successfully used in many applications. The initialization of GVF is automatic. A circle with a given radius placed on the image. A circle centre is given by the centre of the segmented region obtained by the AT method.

Barata, C.; Ruela, M.; Francisco, M.; Mendonça, T.; Marques, J.S.[22] described Adaptive snake method, these are attracted by spurious edges which do not belong to the lesion boundary. These are appears in dermoscopic images due to artifacts such as hair, specular reflections or even from variations in the skin texture. First detects contour snakes in the image using robust estimation algorithm based on the EM algorithm. First detecting intensity transitions along a set of radial directions using correlation matching in the HSV color space. Edge linking by using simple continuity criteria.

3. EXISTING APPROACH

Different approaches are existed for skin cancer detection. In which, a 3D reconstruction method is used. Mainly it focuses the early detection of melanoma. Melanoma is a harmful type of skin cancer. For the detection, the first step is image acquisition. Dermoscopic images are considered for the detection. Then perform image segmentation process, here Active contour method is used. Next step is 3D reconstruction, estimates relative depth of the lesions. Depth is an important factor to diagnose the disease. By using the depth, 2D image is fit into the 3D image. After certain features are extracted and selected for the detection. Final step is classification. Selected images are given into the classifiers and classify the disease.

Skin cancer has different stages. Stages determine the risk of the disease. Depends upon the relative depth, system determines the stages of the disease. So the user gets the idea of the disease. Based on the above information depth is an important factor. This method is known as non invasive computerized dermoscopic system. The first process segmentation, described below.

3.1. Segmentation

The segmentation of skin lesions is an important process. Inaccurate segmentations will affect the feature extraction, feature selection and the final diagnosis. Segmentation separates normal skin and cancerous skin. Different methods are used for segmentation. Accurate segmentations are especially crucial for features that measure properties of the lesion border. Thermoscopic images generally consists of normal skin and skin lesion segments. Identification of the normal skin and skin lesion is critical to accurately extract features. The skin lesions can be identified using segmentation techniques. In which the system considers an adaptive snake (AS) method. Spurious edges not include in the lesion boundary. These are appears in thermoscopic images due to artefacts such as hair, specular reflections or even from variations in the skin texture. Active contour is a curve associated with different energies. The energies in the active contour are Internal and External energy. The Internal energy functions specialize in the intrinsic properties of the contour like snap and curvature, whereas the external energy functions are associated with the image properties like distinction and brightness.

Esnake = Einternal + Eexternal

The problem of finding object boundary is an energy minimization problem.A higher level process or user initiates any cueve close to the boundary.In the end it completely shrinks wraps around the object.

$\alpha Vss-\beta Vssss-E_{img}=0$

It is called force balance equation. Each term associated with the force produced by the respective energies. These curves deforms under the action of these forces.Each curve is associated with the control points and the curve is obtained by joining each control points. Each control point is allowed to move freely under the influence of the forces.

3.2. 3D Reconstruction

It is essential to estimate the depth of the lesions. First Constructs the depth map and then it represent by the structure tensor. Depth map is constructed by estimates the defocus occurrences at each edge locations. Defocus estimation plays an important role in many computer vision application and computer graphics application. An edge is reblurred using guassian kernel function then the ratio between the reblurred and the original image is calculated. The blur scale located at edge location forming sparse depth map. Joint bilateral filtering applied for avoid inaccurate blur estimates. Then propagate defocus blur estimates to entire image And obtain full depth map by applying matting laplacian. The 3D lesion reconstructed is considered as a structure tensor T defined as

$$T = \nabla D^{\rho} . \nabla D .$$

Let ℓ represents a tangential space obtained from the depth map. The structure tensor obtained is used to compute 3D skin lesion features. Three dimensional legion surface S is represented as $S : A \subset D^3 \mapsto D^2$. Where D^3 is the three dimensional space in which A lies. A point A is represented as (X_A, Y_A, D (X_A, Y_A)) where D (X_A, Y_A), represents the depth map.

3.3. Feature extraction & selection

Feature extraction is the process of converting input data into set of features. Here first extract color feature of the dermoscopic skin image. Color is an important characteristics. It helps to detect the skin lesions. skin lesions made variegated coloring and it induces variances in the red, green and blue color channel. To extract the color characteristic, mean and variance of blue, green and red channel is computed separately. Ratio of the channels considered for non uniform complex channels. Next extract texture feature from the image. Gray scale image is used for texture feature extraction. Haralick-features are adopted to obtain the texture characteristics of the skin lesion. 11 Haralick texture features is considered for the feature extraction. Texture features are computed using graytone spatial-dependence matrices.

Then extract 2D and 3D shape features.11 2D features are extracted from the image. It include area A, perimeter P, centroid C, greatest diameter GD, shortest diameter SD.2D shape and 3D shape features are extracted. Also consider shape, border and asymmetry features as 2D shape features. Total number of pixels is the area and the count of the number of pixel on the boundary is the perimeter. Greatest diameter GD connects two longest boundary points and SD connects two closest boundary points. The maximum, minimum and average or relative depth feature is considered as 3D features. Seven Hu invariants and three affine moment invariants are used as 3D features.

Feature selection, selects the set of features and it given in to the classifiers. Feature extraction helps to increases the performance of the classifiers. Here the inclusion of the 3D features increases the performance. It is used to study the effect of color features, texture features, 2D shape features, 3D shape feature and their combinations to classification of skin lesions.

3.4. Classification

Skin lesion classification is the final step of computerized dermoscopy system. In this, three different classes of classifiers i.e. SVM, AdaBoost and the recently developed

bag-of features classifiers are adopted. The classifiers adopted are also referred to as decision making mechanisms. Classification broadly involves two phases namely training and testing. In the training phase, learn the classifiers with respect to the features .In the testing phase test the data and determines the correct class.

4. PROPOSED SYSTEM DESIGN

Proposed system design increase performance of the existing system by changing some algorithms. The combination of SVM and ANN is used in the system and it increases the performance of the system.

4.1. Classification

Skin lesion classification is the final step of computerized dermoscopy system. Classification broadly involves two phases namely training and testing.

In the training phase the classifiers learn from the training set S. Feature properties with respect to the classes are derived in the training phase. In the testing phase we wish to classify test data R .Based on the feature properties observed in training, the decision making mechanisms T classifies a test image I_T represented by feature set F_T as the resultant class C_T. In which SVM and ANN classifiers are used. These features are given as the input to the Artificial Neural Network Classifier and SVM classifier. It classifies the given information set into cancerous or non-cancerous. The methodology incorporates computing and Digital Image process for carcinoma detection.ANN based classifier proved to be very efficient in decision making as well as pattern recognition applications.

5. IMPLEMENTATION

We randomly selected some cancerous and noncancerous dermoscopic skin lesion images for testing the system. After preprocessing and post processing, we segmented the images using GVF segmentation model. Then extracted color, texture, 2D shape and 3D shape features from the images. We selected some features and given to the SVM and ANN classifiers. The 3D features increases the performance and give more accurate results. Evaluate the performance of SVM and ANN classifiers used in the classification.

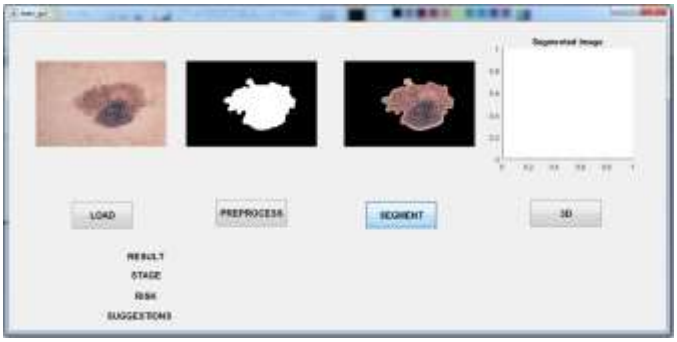

Fig 1: Preprocessed and segmented image

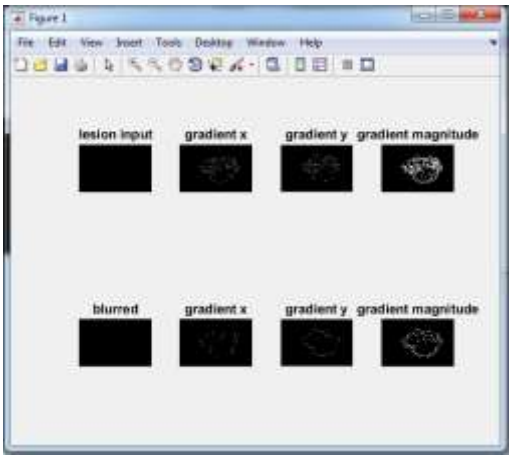

Fig 2: Blurred image of the lesions

Fig 3: Ouput of the system

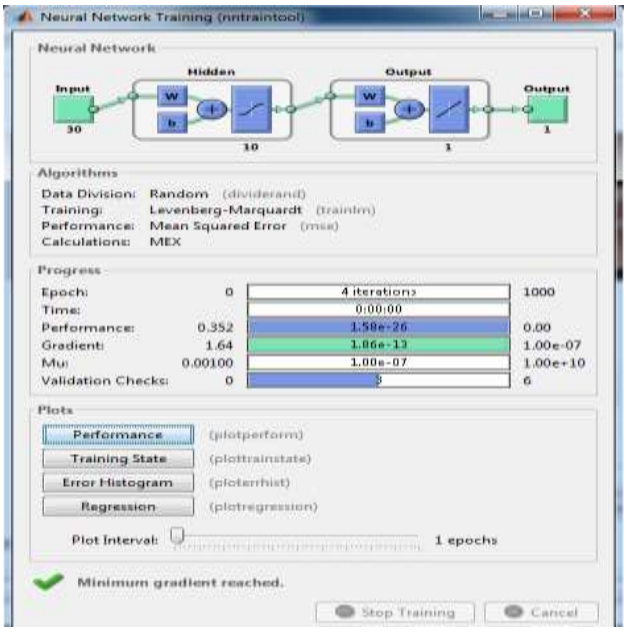

Fig 4: Performance of ANN classifier

	ACCURACY	SENSITIVITY	RECALL	F-MEASURE
SVM ONLY	0.7143	0.7143	0.7143	0.8333
BOTH SVM and ANN	0.8571	0.8571	0.8571	0.9231

Fig 5. Accuracy Of Classifiers

6. CONCLUSION

In this work, a 3D reconstruction of the skin lesion image using two classifiers is proposed. Segmentation, 3D reconstruction, Feature extraction and selection, and the classifications are the main steps involved in this method. Then the classification is performed with the fusion of SVM and ANN Classifiers. Experiments are conducted on PH2 dataset of 300 lesion samples from 2 different classes of skin diseases. The combinations of SVM and ANN classifiers yield better result.

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