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Cancer Detection Using Minimum spanning tree with Hyperspectral Images

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***Abstract* - Cancer remains a major cause of mortality around the world. Survival and life quality of the patients connect straightforwardly to the measure of the essential tumor early discovery of dangerous tissue might move forward both the frequency and the survival. Rather than conventional biopsy, it'll be perfect to put forward the cancer location utilizing intrusive procedures, it can make the treatment more viable and basic Here a self-sufficient classification strategy has been presented that combines both spectral and spatial data on hyperspectral images of a tissue in recognizing cancerous by means of an automatic calculation based on Minimum Spanning Forest (MSF) and Optimal band has been proposed to classify cancerous tissue on hyperspectral images. A support vector machine classifier is prepared to form a pixel-wise classification likelihood outline of cancerous and solid tissue. This outline is at that point used to distinguish markers that are used to compute common data for a run of groups within the hyperspectral image and in this way select the optimal groups. An MSF is at last developed to section the image utilizing spatial and spectral data. The SVM classifier is used to recognize between the typical or irregular tissue based on the MSF Marked region.**

***Keywords*- Hyperspectral imaging, image classification, minimum spanning forest, mutual information, noninvasive cancer detection, support vector machine.**

I. INTRODUCTION

Cancer maybe therapeutic condition that's happening due to the continues development of tissues on the body, all the organs except heart is inclined to cancer. There are chances of spreading the Non malignancies into malignancies. There are different sorts of cancers such as breast cancer, colon cancer, prostate cancer, skin cancer, etc. Day by day the number of the cancer patients is getting increased in number.

It could be a major danger for people around the world, which causes people life expectancy. One of the most causes of cancer is the advanced way of life. cancer affected region in body is identified by biopsy treatment, an intrusive strategy which causes lots of discomfortable to the patients. But the specialized way has created for noninvasive cancer discovery methods are presented.

In this paper, one such cancer identified by image handling. Images such as MRI CT are indeed competent of recognizing cancerous tissues, but for a exact result hyperspectral images are used here. Hyperspectral images, are separated from MRI CTimagesit can gives a spectral signature. The advantage of HSI that wins over MRI is that, the information encoded within the MRI is constrained when compared to HSI, HSI contains a range Of data so that the cancerous tissues can be recognized Accurately. HSI may be a self-sufficient optical imaging is presented used in hyperspectral imaging (HSI). Hyperspectral image has been used in space research areas. But now it is commonto use in medical field also. As the title demonstrates the word 'hyperspectral' implies more than one spectra being in-cooperated in a single image. The hyperspectral image of a tissue will capture feature of the tissue, which isn't conceivable for a typical image. So the preprocessing necessity and the earlier information of the subject are negligible. The application of a appropriate calculation will permit us to extricate the fundamental highlights from HSI.

Here, in this paper Minimum Spanning Forest(MSF) calculation is used. to classify cancer and non-cancer tissue on medical hyperspectral images. MSFs were to begin with presented as a region-based classifier for classification since of its strength to image commotion MSF is its capacity to incorporate all region data into the classification [1].

This permits the chart to normally portion based upon the spectral divergence. The use of MSFs for cancer detection has been investigated utilizing multiband RGB color images [3]. These strategies were able to precisely recognize the HIS image. Segmentations is used to selectcacer affected region for the MSF. These issues are tended to in a assortment of ways, from majority voting Classifications over Region based classifier [14], support vector machines (SVMs) [16]. SVMs have been planned for color image classification on a pixel-wise premise.SVMs has been appeared to effectively utilize earlier information to accurately distinguish characteristics on images with wealthy spectral information such as hyperspectral imaging [6].

Considers have shown that SVMs can be profoundly altered to work well with large scale datasets such as hyperspectral images [8]. Other studies have created successful comes about of combining SVMs with other classification methods [17]. Pixel-wise classification by SVMs in any case isn't well suited to handle classification of regions with comparative concentrated isolated by spatial information, and in this way advance division is required. Coming on to literature survey KhalidMasjoodi [6] et al. proposed an mechanized strategy to help the guess of pathologist. He compared the 2D and 3D unearthly and spatial analysis by utilizing hyperspectral images and classified the colon biopsy samples.

Svetlana V. Panasyuk, Shi Yang, Douglas V. Faller and Duyen Ngo [7] et al. proposed a unused and simple method which combines hyperspectral imaging and spectroscopy and established an calculation for demonstrative reason with training samples and assessed it with test tests. The varieties in the spectral reflectance clearly propose that the tumors can be classified with hyper spectral images. David T. Dicker, Jeremy Lerner, Pat Van Beauty [8] et al. examined the utilize of hyper spectral imaging in analyzing the anomalies in skin tissues the dataset made in this work will offer assistance long run analysts to classify cancer skin tissues with typical HSI.

M. Siddiqi, Hui Li, Michael Hughson and Steven Bigler [9] et al. worked for the scope of recognizing ordinary, precancerous and cancerous tissues using hyperspectral images. H. Akbari et al. [10] conducted a pilot think about in hyperspectral imaging for prostate cancer detection in tumor bearing mice. Spatially settled images were made which highlights the reflectance properties of cancer versus non cancer images.

II. MATERIALS AND METHODS

1. Hyperspectral Imaging System and Image Acquisition

Cermax-type 300 W Xenon light source from the CRI camera system can be used to acquire images from theanimals.The sample is illuminated in the presence of lightfrom the excitation source. The range of scanning time is inbetween 5 s to 1 min [2]. Here the samples taken from boththe animal tissues are being used for analysis [3].The hyperspectral data cube available in 'HDR format' can beconverted to 'IDR format' by tone mapping technique [1].

2. Overview of the Image Classification Method

Fig1 describes the overall system architecture of the proposed cancer detection with Hyperspectral images. This system starts with the pre-processing stage which filters unwanted noise from the image pre-processed and normalized and an SVM classifier is used to perform pixel-wise classification based upon intensity. Highly probable pixels are selected from the SVM results and are used as roots for the MSF Specific bands are automatically selected to use for edge weighting construction in the MSF. The MSF is grown using the constructed weights and markers and Majority voting is performed with the MSF results and the SVM pixel-wise classification.

3. Preprocessing

The preprocessing step is employed to convert the imageinto a form that can made viable for the further processing.Here there are mainly three steps in the preprocessing stage(a) Resizing (b) RGB to Gray conversion and (c) Filtering.The resizing stage is basic step, where the image is beingconverted to the suitable pixel range. For the RGB to Grayconversion the inbuilt method has been adopted. And for thefiltering purpose the Gaussian method has been adopted as it shows in the fig 2

4. Automatic Band Selection

Optimal band choice is the foremost significant step within the work. Every HSI picture comprises of more than hundreds of bands. From these hundreds of groups accessible, as it were some bands might be missed all the highlights fundamental to differentiate the pictures from normal to abnormal bands. The band selection is used to track those groups having that crucial tissue. The ideal band may be practically taken as the edge limits, here it is 50–180. The results that had gotten on applying different ideal bands on a specific test is appeared within the Fig. 2.

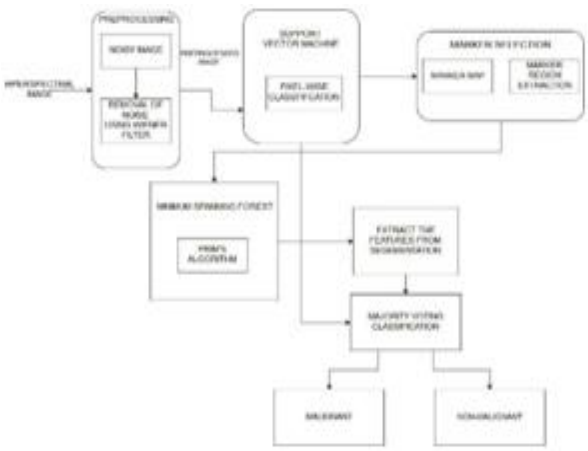

Fig.1. Block Diagram of the classification algorithm using an SVM and MSF.

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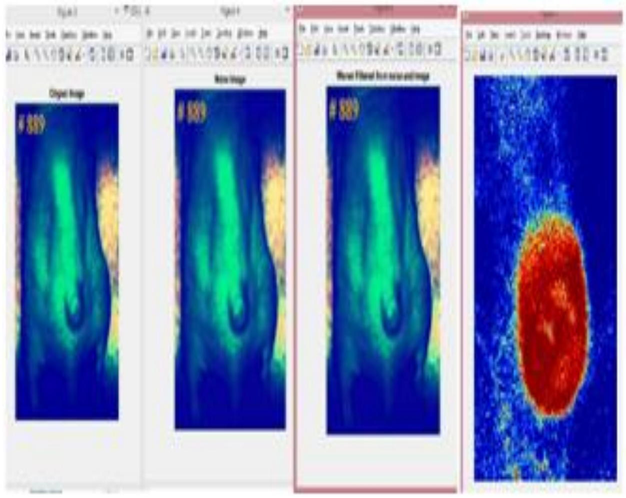

Fig.2. Removal of Noise Using Wiener and optimal band selection.

5. Segmentation

In the image segmentation process, the hyperspectral image isdivided into multiple set of pixels [16]. The main objective of thisstage is to change the representation of images into an easierform for analysis. The Fig. 3 shows the segmentation resultsof a sample image. Here the three segmentation schemesare tested OTSU segmentation, Linear Thresholding andMultilevel thresholding. The multilevel thresholding showsthe best result and it is taken for the proposed method. Andthe threshold limits are the values that had obtained from theoptimal band selection stage as it shown in fig 3.

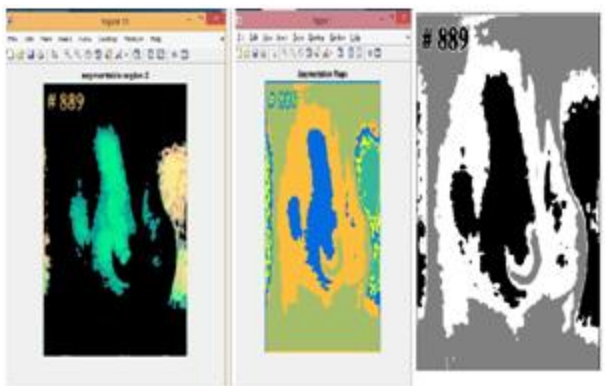

Fig. 3. Segmentation map.

6. Marker Selection

The selected regionare used to differentiate several features in the segmented result. Region based Markers are selected based onthe probabilistic analysis of the intensity features. A pixels having the common intensity profile may be assigned as one region. One particular pixel corresponding to everycluster may be taken as the reference, then it compares thenearby pixels, those pixels having a similar intensity profilemay be added to the reference. Such regions having more thanpixels may be taken as the markers. The marker selectionin two different data sets is shown in Figs. 4

7. MSF Based Feature Extraction

Minimum Spanning Forest is formed from numerous minimumspanning trees, where various minimum spanning trees are connected together so that it does not form a closed loopwith minimum edge weighting possible. Here the MSF ispreferred because it is capable enough to detect the pixeldistribution of the image by utilizing the intensity features.The markers would encapsulate both the normal and malignanttissues. The malignant tissues show a unique property that itoccupies with maximum density at minimum area, whereas thenormal tissue will possess the markers distributed in nature.The MSF will only selects the marker showing malignanttissues from the numerous markers available. The Markerselection and MSF results in 2 distinct tissue images are shownin the Fig 4.

$$\mathrm{SAM}(p_i, p_j) = \cos^{-1} \frac{\sum_{b=1}^{B} p_{ib} p_{jb}}{\sqrt{\sum_{b=1}^{B} p_{ib}^2 \sum_{b=1}^{B} p_{jb}^2}}.$$

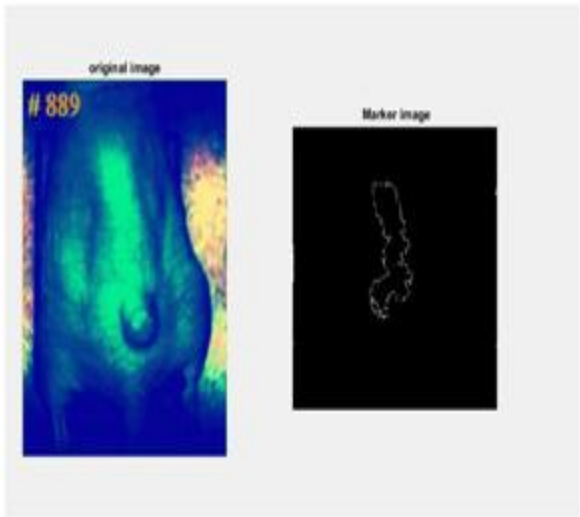

Fig. 4. Marker Map (Extracting Region).

8. Classification

Once a feature is being extracted with the application f MSF algorithm, that tissue will be abnormal. The SVM(Support Vector Machine) is used to classify images intonormal and abnormal, based on the MSF result. Here thearea and size feature are being taken as the kernels. Theclassification results of two sample images are shown in the Figs 5(a)

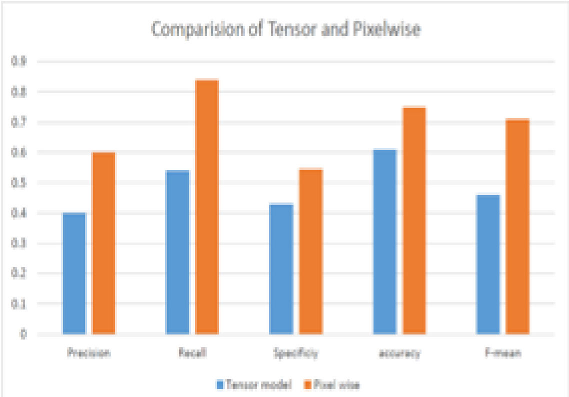

Fig.5 The performance of the Tensor-1, Pixel classification methods.

We compared the tensor and pixel classification methods as shown in Fig. 6

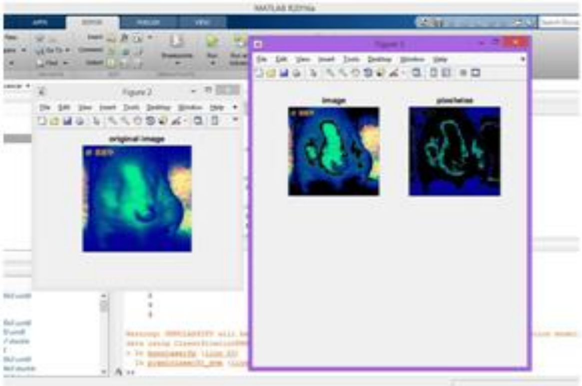

Fig.5(a). SVM Pixel wise classification.

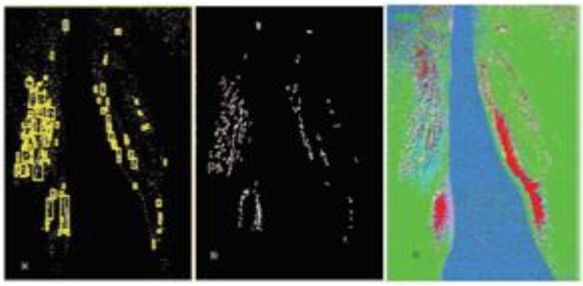

Fig.5. (b) minimum spanning forest in normal tissue.

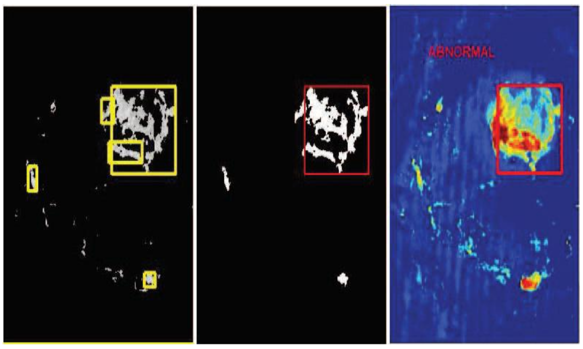

Fig.5. (c) minimum spanning forest in abnormal tissue.

III. RESULTS AND DISCUSSION

The first step in the proposed method is the pre-processingstep which is shown in the Fig. 2. Where there are mainly threesteps as mentioned earlier, resizing, rgb-to-gray conversionand finally filtering is provided to remove the unwantedcomponents from the image. It is illustrated in Fig.1 and respectively. The segmentation result of one sample image is shown in the Fig. 3. Here the multilevel thresholdingis used as the segmentation scheme, where the threshold limitswere taken from the optimal band limit. And it had taken asthe optimal band in the proposed work.Then the markers are to be selected, from the segmentedoutput.

The markers are selected according to the intensityprofile in the segmented image. Every accumulated zones inthe segmented result can be classified into large and smallbased on the number of pixels associated with the each marker.Those regions having more than more than M pixels may betreated as large region, whereas those having less than M pixelscan be treated as small region. There can be more than onemarker in a single image. It is shown in the Fig. 4.In the markers selected, MSF algorithm may be applied forfeature extraction. From the available markers the malignantregion if there, may be appeared in an accumulated fashion.

Whereas the normal region may appear in a scattered formThe MSF actually selects the region based on theclassificationcriteria that maximum pixels distributed in a minimum area.If it is possible to find one such zone from the markers, itcan be concluded that the sample is abnormal, if there is nosuch zones, and then it will be normal. The final classification may be executed with the SVM classifier. The SVM classifierhelps to differentiate the image into normal and abnormalbased on the MSF result. It actually utilizes the size feature insegmented result. The corresponding MSF results of abnormaland normal tissues are shown in the Figs. 5(a) the final classification result for malignant and non-malignant is showed in fig5(a)(b)(c) respectively.

IV. COCLUSTION

Here a noninvasive cancer detection using HSI is being Introduced. It was implemented using optimal band selectionand minimum spanning forest algorithm. The optimal band selection helps to improve accuracy and efficiency. The techniqueis being tested with various cancer tissues of the animals.The results show that HSI could be used as an efficient opticalimaging tool and can be used as annoninvasive visual aidtool. The final classificationcan be implemented by analyzing MSF results.

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