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Automated Detection of Skin Cancer and Skin Allergy

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Abstract: ***Skin cancer is a malignant tumour which grows in skin cells. It is one of the most common of all cancer which affects human beings and accounts for more than 50% of all types of cancers around the world. Skin cancer is skin's unwanted growth with differing causes and varying degrees of malignancies. It can spread very fast to all organs/parts of human body through lymphatic system or blood. The incidences of melanoma - the deadliest form of skin cancer has been on rise at an alarming rate of 3% per year. Detection of malignant melanoma in its early stages considerably reduces morbidity and mortality. Skin cancer can be cured at very high rates with simple and economical treatments, if detected at its earlier stages .Presently there is a greater need of automatic diagnosis of skin cancer for masses at an early stage. This dissertation presents automated skin cancer detection system. The basic aim of this "automated detection of skin cancer and skin allergy" is a simple, efficient and automatic skin cancer, detection and diagnosis system with the use of commonly available software for non-experts/clinicians/doctors. Image is pre-processed by using median filter for removing the noise. Then image is segmented by using Fuzzy C-Means (FCM). Then Grey Level Co-Occurrence Matrix (GLCM) is used for textural feature extraction. Extracted textural features are energy, homogeneity, entropy, contrast, correlation, cluster shade prominence, variance information measure of correlation, dissimilarity. Then Classification of skin cancer is done by using Support Vector Machine (SVM). Skin lesion doesn't have similar features in the selected area. So SVM will give better performance. SVM is used to classify whether the type of skin cancer or skin allergy. Finally the performance of the proposed system will be verified by calculating the parameters such as Mean Square Error (MSE) and Peak Signal to Noise Ratio (PSNR). And SVM also detects the percentage area of affected skin.***

Key words: Melanoma, skin Allergy, FCM, SVM, GLCM, PSNR, MSE.

I. INTRODUCTION

The awareness of the biomedical technical public for computer maintained dermoscopic pictures of skin inspection and characterization has been increased through the past years. Cancer of skin is almost the furthermost frequent categories of cancer and some of the peak malignant cancers. Diagnosis of malicious malignancy is a laborious task since other skin injuries can have similar physical physiognomies. In many cases, dermatologists must perform a biopsy (a laboratory medical procedure) to make certain whether a cancer is malignant or benign. Cancer of skin is the maximum communal one and denotes 50% of all the new cancers invented each year. In about 1.2 million of new categories of skin cancer cases/patients detected in the United states [9]. Every year, malicious melanoma is the deadliest one, accounting for over 7300 deaths per year in United States. Though, if identified at an initial platform, cancer of skin has a very high remedy rate, and requires rather simple and economical treatments. Quite the opposite, when discovered at a last stage or at a late platform, tumorous lesion have very extraordinary morbidity and mortality rates, and an extremely great charge supplementary with accurate diagnosis and the necessary treatment. Melanoma is some of the categories of cancer of skin that stand up from the pigmented developing cells of the skin called melanocytes. The majority forms of categories of skin cancer are from excessive sun contact. Less than half of malignancies stand up from moles while the majority of categories stand up on normal appearing skin. Melanoma is the maximum hazardous of the common categories of skin cancer. Melanoma usually appears as an enlarging coloured skin spot.

Melanocytes have several shades of brown, black and blue. They can be even or raised. A tiny section of melanoma are not multi-coloured, but show as a changing "skin coloured" spot. Because of this, any changing skin spot should be reported to our doctor.

Remember that the mainstream of melanoma have no warning signs when they are found. Some may be irritated, and flow of blood is a late sign. Melanoma, like other categories of skin cancers, is only very rarely annoying to the touch. In the mainstream of cases they are detected solely by their appearance. It is very essential to eradicate a melanoma early in its life. This is because "thin" melanomas have a very noble projection (96% cure rates). Consequently primary finding is so much important in controlling the disease. The maximum common spot for malignancy in men and women are different. In men it is the back and in women the legs. However, you should check all of our skin. The main familiar risk part for developing melanoma is having plenty of moles. Other significant danger factors include a heredity of melanoma, an individual history of malignant cells or other forms of skin cancer, spotted or pale skin (skin that tends to burn up rather than tan), and frequent leisure sun exposure. While malignant cells can occur in childhood it is rare before teenage years. Melanoma is also exceptional in the native, Asian and in the African races.

Other category of skin cancer i.e Basal cell skin cancer which is one category of skin cancer invents in the basal cell covering of the skin. It generally found in places that have been in the contact with sun so frequently. For example, the face is the mainly frequent habitation to find basal cell skin cancer. In persons with fair-haired coating, basal cell skin cancer is the maximum widespread category of skin cancer. Another category of skin cancer i.e. squamous cell skin cancer found in squamous cells. In those people with shady skin, squamous cell skin cancer is the more frequent category of skin cancer, and it's regularly found in places that are not in the more contact with sun, such as the leg or foot. However, in those people with fair-haired skin, squamous cell skin cancer frequently occurs on covering of the membrane that have existed in the contact with sun, such as the head, face, ear, neck. Fig.1.1 (a) shows normal skin and fig .1.1 (b) shows infected skin.

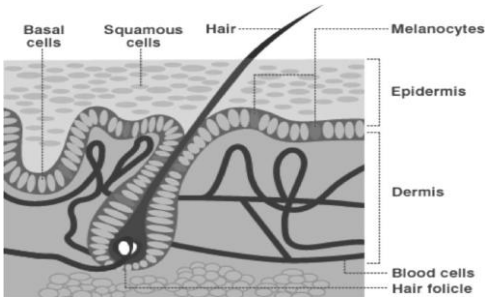


Fig 1.1 (a) Normal skin

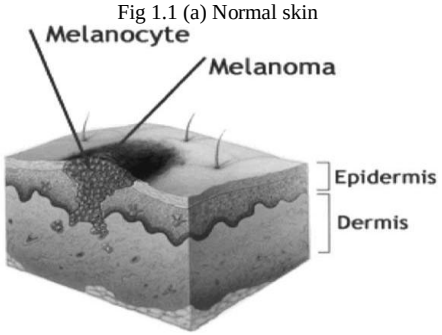


Fig 1.1 (b) Infected skin [14]

Fig 1.2 shows asymmetric melanoma while fig.1.3 shows basal cell carcinoma as shown below

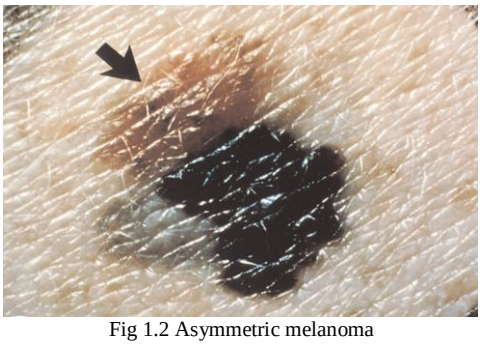


Fig 1.2 Asymmetric melanoma

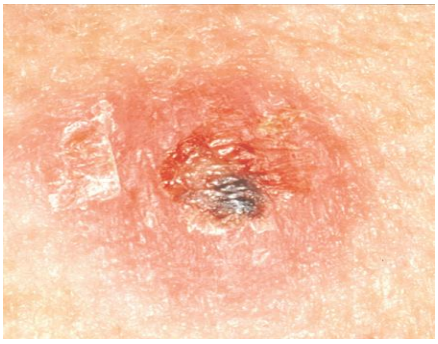


Fig1.3 A sore or lump that bleeds or develops a crust or a Scab

This paper presents automated detection of skin cancer types and skin allergy by using fuzzy c means segmentation. SVM classifier is used to classify whether the infection in the skin is a type of cancer or a simple allergy. Extracted textural features of GLCM are homogeneity, energy, correlation, contrast. Finally using the PSNR and MSE values performance of system will be evaluated.

II. TECHNICAL REVIEW

Scott E.Umbaugh et. Al, [2] proposed "Applying Artificial Intelligence to the Identification of Variegated Colouring in Skin Tumors "here used automatic induction to generate classification rules.

F.Ercal, M.Moganti, V.Stoecker, and R.H.Moss [3], proposed general procedure for extracting border detection of colour image data. Therefore removing noise median filter used. Furthermore, using histogramming, and an approximate colour fostrnsegmentation strategy. They found that spherical transformations and chromaticity transformations provided the highest diagnostic accuracy. Thresholding is a widely used tool in image segmentation for identifying the different homogeneous components of the image. They presents a simple yet effective border finding algorithm targeted to colour image of skin tumors. The technique is based on segmentation algorithm that used an adaptive transformation function followed by thresholding.

Fikret Ercal et al [4], studied the diagnose melanoma from colour skin images using an artificial neural network. Present a novel neural network approach for the automated separation of melanoma from three benign categories of tumors which exhibit melanoma-like characteristics. Their approach uses discriminant features, based on tumour shape and relative tumour colour that used for artificial neural network for classification.

Philippe Schmid [5], proposed a colour-based segmentation scheme applied to dermatoscopic images. A two-dimensional histogram is computed with the two principal components and then smoothed with a Gaussian low-pass filter. Segmentation used Fuzzy C-Means clustering technique.

Do Hyun Chung et al [6], proposed segmenting skin lesions with partial-differential-equations-based image processing algorithms. A partial-differential equations-based system for detecting the boundary of skin lesions in digital clinical skin image is used. Segmentation done by the geodesic active contoures model or the geodesic edge tracing approach.

Harald Ganster et al [7], proposed Automated Melanoma Recognition. A system for the computerized analysis of images obtained from ELM has been developed to enhance the early recognition of malignant melanoma. Segmentation, mainly region-based segmentation methods are applied, and within this category the thresholding operation is most often used. Feature calculated by ABCD-rule.

Tim K. Lee et al [8], proposed counting moles automatically from back images. Develop an unsupervised algorithm for segmenting.

Xiaojing Yuan et al [9], proposed SVM-Based texture classification and application to early melanoma detection. They explore texture information, one of the criteria dermatologists use in the diagnosis of skin cancer, but found very difficult to utilize in an automatic manner. The objective is to use texture information only to classify the benign and malignancy of the skin lesion. A three-layer mechanism that inherent to the Support Vector Machine methodology.

Liu Jianli et al proposed the segmentation of skin cancer image based on genetic neural network. Proposed the genetic neural network to use to segment the skin cancer images. Optimization of weights and thresholds in neural network based on genetic algorithm is executed to improve the convergence speed of the BP neural network.

Jose Fernandez alcon et al [10], proposed Automatic imaging system wiyh decision support for inspection of pigmented skin lesions and melanoma diagnosis, they describe an automatic system for inspection of pigmented skin lesions and melanoma diagnosis, image used by digital camera. System includes a decision support component, which combines the outcome of the image classification with context knowledge such as skin type, age, gender, and affected body part. They found that our system classified image with an accuracy of 86%, with a sensitivity of 94%, and specificity of 68%.

B. Garcia Zapirain et al [11], proposed Skin cancer parameterisation algorithm on epiluminiscence image processing. The algorithm is based on the standard ABCD dermatologic protocol. The database used consists of 65 images already catalogued by dermatologists and the results are successful according to the assessment of medical experts.

Ho Tak Lau et al [12], proposed automatically early detection of skin cancer: study based on neural network classification. Different types of neural network are studied with different types of pre-processing. Useful information can be extracted from these images and pass to the classification system for training and testing. Recognition accuracy of the 3-layers back-propagation neural network classifier is 89.9% and auto-associative neural network is 80.8% in the image database that include dermoscopy photo and digital photo.

Margarida Silverira et al [13], proposed Comparison of segmentation methods for melanoma diagnosis in dermoscopy images. Many segmentation methods are used adaptive thresholding, adaptive snake, EM level set, Fuzzy-based split-and-merge algorithm. The best results were obtained by the AS and EM-LS methods. The best fully automatic method was FBSM, with results only slightly worse than AS and EM-LS.

Ilias Maglogiannis et al [14], proposed overview of advanced computer vision systems for skin lesion characterization. The extract features through digital image processing methods, i.e. Segmentation, border detection, and colour and texture processing, and prominent techniques for skin lesion classification.

Huiyu Zhou et al [15], proposed anisotropic mean shift based fuzzy c-means segmentation of dermoscopy images. Image segmentation is important task in analysing dermoscopy images as the extraction of the borders of skin lesions. Fuzzy c-means clustering algorithm used. They introduce a new mean shift based fuzzy c- means algorithm that requires less computational time than others.

Sookpotharom Supot, et al [16], proposed border detection of skin lesion images based on fuzzy c- means thresholding. As the first step of image analysis, pre-processing median filtering. In next fuzzy c-means thresholding technique is used to segment and localize the lesion.

Shang Keke et al [17], proposed study on skin colour image segmentation used by fuzzy-c-means arithmetic. Compared RGB, HSV and Lab colour spaces and found that HSV colour space as segmentation feature parameter has the advantage. Here used improved fuzzy c- mean arithmetic in skin colour image segmentation.

Azadeh Noori Hoshyar et al [18], proposed review on automatic early skin cancer detection. Feature extract by pattern analysis, the ABCD-rule of dermatoscopy, The ELM 7-point checklist, Menzies Method, texture analysis.

Lucia Ballerini et al [19], proposed non-melanoma skin lesion classification using colour image data in a hierarchical k-nn classifier. The accuracy of the proposed hierarchical scheme is higher than 93% in discriminating cancer and pre-malignant lesions from benign lesions, and it reaches an overall classification accuracy of 74% over five common classes of skin lesion.

R. Subash Chandra Boss et al [20], proposed mammogram image segmentation using fuzzy c-means clustering algorithm. The median filter is used for pre-processing of image. The 14 haralick feature are extracted from mammogram image using gray level co-occurrence matrix for different angles. Summarize the methods as,

The detection of abnormalities has been found in skin colour only. In general, mentioned the change in normal skin by colour Artificial intelligence only but didn't defined specifically [2].Again they found the image segmentation by using histogramming. Thresholding is widely used technique. They presented the effective border defining algorithm targeted to colour image of skin tumors [3].By using the artificial neural network the diagnosis of melanoma can be performed with the help of skin colour identification [4].

Developed an unsupervised algorithm for identification more precisely than the previous methods. Partial differentiation equations are used for boundary detection [6]. Proposed system classified image with an accuracy of 86%, with a sensitivity of 94%, and specificity of 68% [9]. . Useful information can be extracted from these images and pass to the classification system for training and testing.

One challenge in implementing such a system is locating the skin lesion in the digital image. In Proposed method a novel texture-based skin lesion segmentation algorithm is proposed. And classify the stages of skin cancer using Fuzzy c-Means. Because in skin lesions lot of stages are there so fuzzy C-means will give better performance in this system. The proposed framework has higher segmentation accuracy compared to all other tested algorithms.

III. BLOCK DIAGRAM

Methodology flow is the conceptual model that defines the algorithm. Methodology block is as given in below figure .An algorithm explanation is a formal description and representation of a flow.

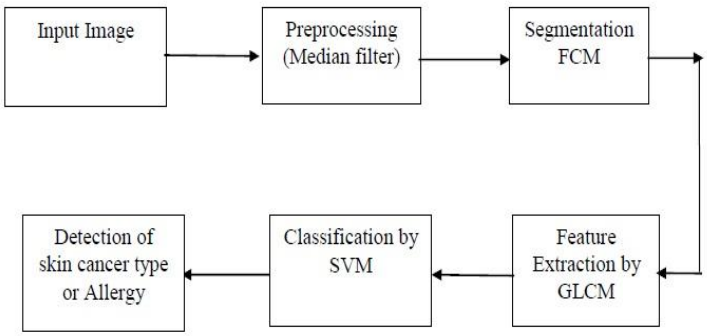


Fig 1.4 Block Diagram

A.SVM Designed for Classification

The machine learning algorithm is used as the classifiers trained using the image features as dataset and perform an energetic role in image classification. The classifiers are categorized either as supervised or unsupervised learning algorithms.

In supervised learning algorithms, the classes are finite predetermined sets that are labelled and are classified into different groups carrying similar features. Thus a mathematical model is constructed in the training phase and is useful to calculate the pattern during the testing phase.

In unsupervised algorithm, the classifications are not provided initially and the labels are developed automatically. This algorithm seeks a similarity in the middle of a set of data called clusters in direction to form a classification group. It is apparent that the supervised learning algorithm classifies better incorporating the additional knowledge obtained during the training process. SVMs are some of the supervised learning algorithms and are well thought-out to be there a popular classification tool for pattern recognition. SVM is an advantageous procedure for data classification. Even though it's measured that Neural Networks are easier to use than this, however, sometimes unsatisfactory results are obtained. A cataloguing task generally consist of training and testing data which is made up of some data instances. Every single instance of the training set have one target values and several attributes.

The aim of SVM is to create a model which forecasts target value of data instances in the testing set which are assumed only the attributes [9].Classification in SVM is an example of Supervised Learning. Identified tags help to point toward whether the system is carrying out in a right way or not. This statistics points to a required reaction, authorising the truthfulness of the classification, or be used to support the classification system study to perform correctly. A step in SVM classification contains identification by means of which are confidentially linked to the known classes. This is called as feature selection or feature extraction. Feature selection and SVM classification collectively take a usage even when forecast of unidentified samples is not necessary. They may be used to identify key sets which are involved in whatever processes distinguish the classes.

IV. ALGORITHMS

a) For preprocessing skin cancer image

1. Read image.

2. Separate R, G and B plane from color image.

3. Apply median filter on each of above 3 planes separately.

4. Combine above 3 planes to form noise filtered color image.

5. Increase contrast of image using imadjust function.

b) For Segmentation skin cancer image

1 Convert above image into vector.

2 Apply FCM algorithm on this image vector to form two different clusters. One of these clusters corresponds to background skin and other corresponds to cancer region.

3 If number of pixels corresponding to cluster 1 is more than of cluster 2 then cluster 1 is background and cluster 2 is cancer region.

4 Above result may contain some unwanted small region which are not corresponding to actual cancer. To remove those, areas of all isolated regions is calculated. Only the object that is corresponding to maximum area is kept and all other small areas are removed.

5 Result of FCM is BW image and it contains background as black and cancer region as white pixels. Pixels those are black in this image are also made black in original grey image. This will remove skin part and keep only part that corresponding to cancer.

c) For Feature extraction

1. Get GLCM feature of gray image above.

2. Find centroid of cancer region using graycomatirx and graycoprps function.

3. Find edge boundary pixels of cancer region by using canny edge detection method

4. Find distances between centroid and peripheral point lying along 36 angles separated

5. Find standard deviation of contour signature.

d) For Support Vector Machine

1. For feature vector using the features Contrast, Correlation, Energy, Homogeneity, standard deviation, eccentricity, and perimeter.

2. Pass these features to SVM classifier.

3. If resulting class is '1' then it skin cancer type is melanoma. If resulting class is '2' then its basal cell carcinoma.

V. GLCM FEATURES

There are many Features extracted by using Grey Level Co-occurrence Matrix (GLCM) for the textural analysis. Features those we will consider in this dissertation are listed below [21]:

1 *Autocorrelation:* In any time series containing non-random patterns of behavior, it is likely that any particular item in the series is related in some way to other items in the same series and can be described by autocorrelation function and / or autocorrelation coefficient.

$$f(x).g(x) = \int f(a).g(x/a))dx \qquad 1$$

If $f(x)\ and\ g(x)$ are the same functions $f(x).g(x)$ is called autocorrelation function.

2 *Contrast:* Contrast is the difference in luminance and / or colour that makes an object (or its representation in an image or display) distinguishable. In visual perception of the real world. Contrast is determined by the difference in the colour and brightness of the object and other object within the same field of view.

$$\frac{Luminance\ difference}{Average\ Luminance}$$

$\sum_{n=0}^{G-1} n^2 \{\sum_{i=1}^{G}\sum_{j=1}^{G} p(i,j)\}$, **(i** -j)=n 2

3 *Correlation:* Correlation is a measure of grey level linear dependence between the pixels at the specified positions relative to each other.

$$\frac{\sum_{i=0}^{G-1}\sum_{j=0}^{G-1}\{i\times j\}\times P\{i\times j\}-\{\mu x-\mu y\}}{\sigma x\times\sigma y} \qquad 3$$

4 *Cluster Prominence:* Cluster prominence is measure of the skewness of the matrix, in other words the lack of symmetry. When cluster prominence is high, the image is not symmetric w.r.to its texture values.

Prominence=$\sum_{i=0}^{G-1}(i+j-\mu x-\mu y)^4 \times P(i,j)$ 4

5 *Cluster Shade:* Cluster Shade is also a measure of the skewness of the matrix, in other words the lack of symmetry. When cluster shade is high, the image is not symmetric w.r.to its texture values.

Shade=$\sum_{i=o}^{G-1}(i+j-\mu x-\mu y)^3 \times P(i,j)$

$\sum_{i,j}^{i,j}\{(i-\mu i)+(j-\mu j)\}^3 C(i,j)$ 5

Where C (i,j) is the (i,j)th entropy in a co-occurrence matrix C.

$\sum i=\sum_{i=1}^{i=M}$ where M is the no. of rows

$\sum j=\sum_{j=1}^{j=N}$ where N is the no. of columns.

$\sum I,j=\sum i\sum j$

$\mu i=\sum i\sum jC(i,j)$

$\mu j=\sum jC\sum C(i,j)$

6 *Entropy:* Entropy is a statistical measure of randomness that can be used to characterize the texture of the input image.

P=-pixel count.*log($pixel\ count$) 6

Entropy Value=-sum (p)

Pixel count are total no.of pixels in image region. Calculated from the histogram of the grey image region and the variable p means temporary variable to calculate entropy. Entropy can also be shown as:

-sum (P.*log 2(p)) 7

Where P contains the histogram count. Image (I) can be a multidimensional image. If I have more than two dimension, the entropy function treats it as a multidimensional grayscale image and not as an RGB image.

7 *Homogeneity:* Homogeneity consists of two parts i.e. Standard deviation and the discontinuity of the intensities at each pixel of the image.

$Hij=1-(\frac{Sij}{Smax})\times(\frac{Dij}{Dmax})$ 8

8 *Sum of Squares:* Sum of squares is also called as variance.

$Variance=\sum_{i=0}^{G-1}\sum_{j=0}^{G-1}(i-\mu)^2P(i,j)$ 9

9 *Sum Average:*

$AVER=\sum_{i=0}^{2G-2}iP\mathcal{X}+\mathcal{Y}(i)$ 10

10 *Sum Entropy:*

$SENT=-\sum_{j=0}^{2G-2}Px+\mathcal{y}(i)\log P(x+\mathcal{y}(i))$ 11

11 *Difference Entropy:*

$DENT=-\sum_{I=0}^{G-1}Px+\mathcal{y}(i)\log P\big(x+\mathcal{y}(i)\big)$ 12

12 *Information Measure of Correlation 1*:

$\frac{HXY-HXY1}{max\{HX,HY\}}$ 13

13 *Information Measure of Correlation 2*:

(1- exp $[2.0(HXY2-HXY)]$)$^{1/2}$ 14

HXY=-$\sum_i\sum_j P(i,j)\log P(i,j)$)

HXY1=-$\sum_i\sum_j P(i,j)\log\{Px(i)P\mathcal{y}(j)\}$

HXY2=-$\sum_i \sum_j Px(i)Py(j) \log\{Px(i)Py(j)\}$

By using above features of GLCM values for textural features are calculated. With the help of these equations values calculated are more accurate. Calculated parameters with the help of these equations are tabulated in the chapter result.

14 *Peak Signal to Noise Ratio*: To analyze the quality of the embedded texture image, with respect to the original, the measure of PSNR has been employed. PSNR of the obtained image can be computed by,

$$PSNR = 10 \times \log_{10} \frac{255^2}{MSE}$$

$$=10 \times \log_{10} \frac{255^2}{(2K-1)} \quad \text{dB} \qquad 15$$

15 *Mean Square Error:* Mean square error (MSE) is a measure used to quantify the difference. If the image has a size of M × N then,

$$MSE = \frac{1}{M \times N} \sum_{i=1}^{M} \sum_{j=1}^{N} (a_{ij} - b_{ij})^2 \qquad 16$$

Statistical Analysis is done by using MSE and PSNR.

16 *Accuracy:* Accuracy values for both segmentation techniques i.e. for FCM and DWT are calculated by using the formula as below,

$$Accuracy = \frac{Tp+Tn}{Tp+Tn+Fp+Fn} \times 100 \qquad 17$$

Where,

Tp = True Positive Value

Tn = True Negative Value

Fp = False Positive Value

Fn = False Negative Value

VI. RESULTS

Images for the database are taken from K.E.M.Hospital, Mumbai. Images taken are for two category of skin cancer: Melanoma and Basal Cell Carcinoma. And images for skin allergy are also taken. Here software MATLAB 13[22] version is used for algorithm implementing the proposed methodology. The input mage is taken from database.

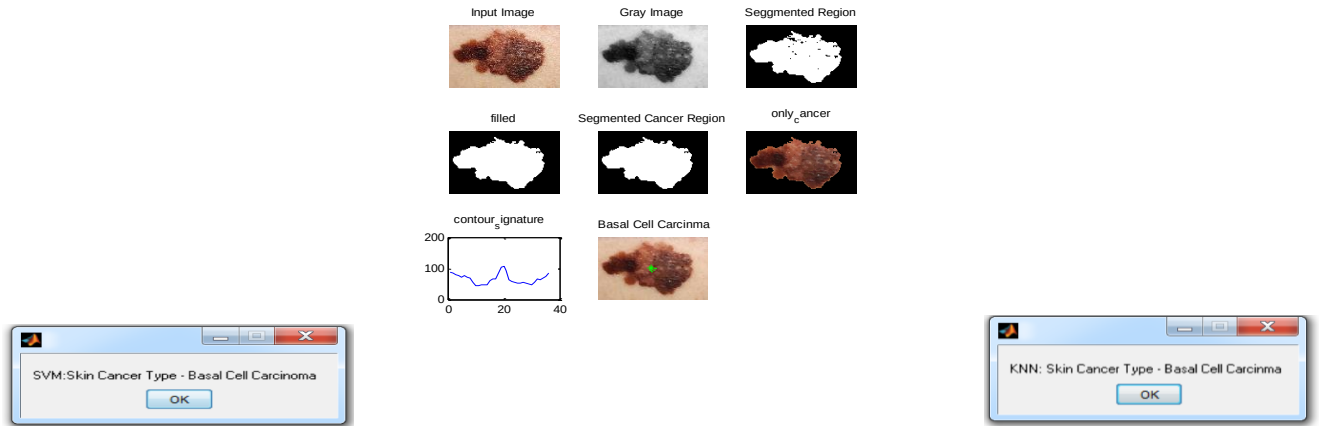


Fig 1.5 Output of Basal Cell Carcinoma

Here taken image for basal cell carcinoma. The input image is taken from database, then it will converted into gray image. Gray image will go through segmentation process of type fuzzy c-means. From the segmented image the filled state will be

extracted and finally conclude the exact location of cancerous region and percentage of that particular cancer. Percentage area for the above database image is 46.4417.Standard deviation and eccentricity calculated are 15.3152 and 0.7357 resp. Results are compared with KNN and SVM classifier. Here both classifier shows the same result.

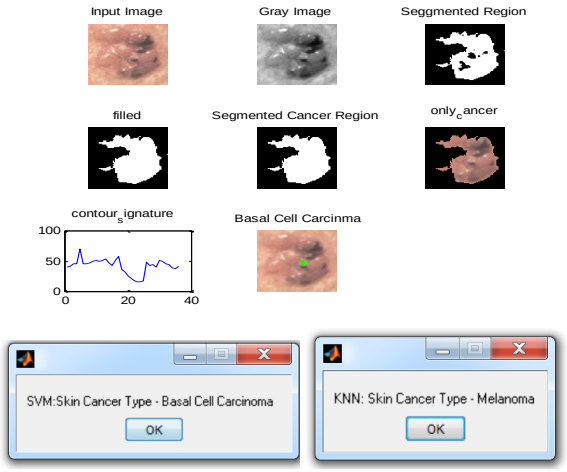


Fig 1.6 Output of Basal Cell Carcinoma

Here both classifier shows different result. SVM shows the accurate result of basal cell carcinoma but KNN shows different result of melanoma. Sometimes Results of KNN don't match with the results of SVM. But SVM always shows the correct result. The percentage area is 58.5723. And the std.deviation and eccentricity are 40.4232 and 0.4359.

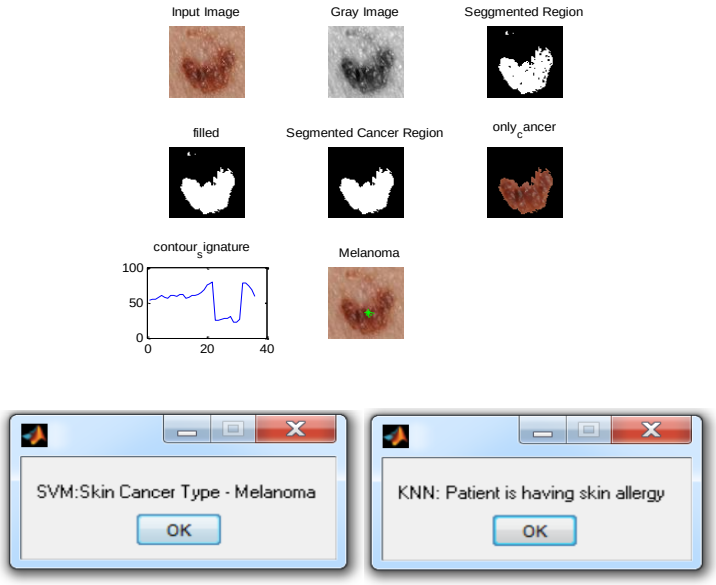
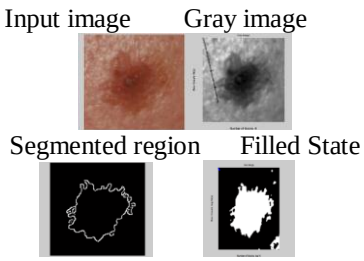


Fig 1.7 Output of Melanoma

The above image is taken for the cancer type of melanoma. The percentage area is 19.5313 and std.deviation and eccentricity calculated are 33.1448 and 0.9497. SVM shows correct result while KNN shows result of skin allergy which is different from collected database.



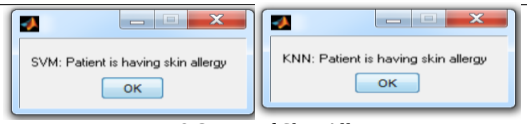


Fig 1.8 Output of Skin Allergy

Here image is taken for skin allergy. Percentage of skin Allergy is 19.5313.Here both classifier shows the same result i.e. results from both classifier are matching. The std.deviation and eccentricity calculated are 33.1448 and 0.9497. In skin Allergical image the process only converts image into gray image, segmented region and filled state. And finally shows the result i.e. having skin allergy. Skin allergy database doesn't go through all the process as in the skin cancer detection.

Values for autocorrelation,contrast,correlation,cluster prominence, cluster shade, energy, entropy, homogeneity, dissimilarity, maximum probability, sum average,sum variance, variance,sum entropy, difference variance, difference entropy, information measure of correlation, inverse difference, inverse difference normalised, inverse difference moment normalised are tabulated in the table given below.

A .Output values of GLCM textural features:

IMAGE / FEATURES	1	2	3	4	5	6	7	8	9
AUTOCORR	17.1819	21.3483	20.9082	22.9928	33.7708	28.4023	34.1868	37.6106	28.6094
CONTRAST	0.1962	0.2501	0.1050	0.0764	0.3647	0.6678	0.6141	0.5916	0.3834
CORR.	0.8254	0.8555	0.9302	0.8005	0.8442	0.9041	0.8492	0.8782	0.9634
CLUSTER PROM	0.8254	0.8555	0.9302	0.8005	0.8442	0.9041	0.8492	0.8782	0.9634
CLUSTER SHADE	11.6337	31.1043	33.1753	1.9269	75.4559	305.3724	136.5880	281.0890	703.6996
DISSIM	-0.3766	-5.5000	-7.4036	-0.8107	-10.7810	-22.1385	-18.8345	-35.3255	-54.1130
ENERGY	0.1949	0.2374	0.1035	0.0718	0.3299	0.4718	0.5246	0.4280	0.3169
ENTROPY	0.2676	0.2903	0.4813	0.5812	0.1819	0.1153	0.1220	0.2318	0.1459
HOMOGEN	1.6954	1.8109	1.2330	0.8417	2.1023	2.7129	2.4270	2.3073	2.4418
HOMOGEN	0.9027	0.8833	0.9485	0.9629	0.8403	0.7929	0.7523	0.8094	0.8518
MAX PROB	0.9027	0.8826	0.9484	0.9628	0.8385	0.7834	0.7467	0.8020	0.8482
VARIANCE	0.4457	0.5079	0.6785	0.7383	0.3582	0.2308	0.2039	0.4577	0.3024
SUM AVG	17.2048	21.3352	80.8295	22.8909	33.9688	28.6249	34.2977	37.7269	28.5974
SUM VAR	8.1777	9.0792	8.9908	9.5582	11.4519	10.0509	11.3943	11.9125	9.7081
SUM ENT	45.8846	58.8470	64.2820	77.6592	96.8729	73.8036	96.5126	109.0755	77.3456
DIFF VAR	1.5568	1.6203	1.1564	0.7849	1.8305	2.2697	1.9613	1.9150	2.1734
DIFF ENT	0.1962	0.2501	0.1050	0.0764	0.3647	0.6678	0.6141	0.5916	0.3834
INF.COR 1	0.4966	0.5686	0.3356	0.2682	0.6832	0.8875	0.8408	0.8392	0.6983
INF.COR2	-0.4968	-0.4716	-0.6394	-0.5476	-0.3968	-0.4468	-0.3503	-0.3835	-0.5563
INH	0.8224	0.8205	0.8289	0.6861	0.8049	0.8888	0.8022	0.8158	0.9208
IDN	0.9784	0.9738	0.9885	0.9917	0.9637	0.9497	0.9427	0.9542	0.9655
IDMN	0.9970	0.9962	0.9984	0.9988	0.9945	0.9901	0.9907	0.9912	0.9942

Fig 1.9 table for GLCM textural features

B. Comparison for SVM and KNN Classifier:

Equated results of SVM with the outputs of KNN method. Here K=1.The output values are tabulated in the table given above. Results obtained by SVM are further truthful than the results obtained by KNN method.Results are checked with the results of medical practitioner and the results are matching. The comparison graph of SVM and KNN Values is shown. In this Graph red colour is taken for the graphs of SVM and blue colour is taken for the graphs of KNN values. It shows that SVM values graph lies above the KNN values graph that means SVM classification is far better than the KNN classification.

TYPES	SVM No.of Input images	Correctly Identified images	Accuracy
MELANOMA	35	31	88.5718 %
BASAL CELL CARCINOMA	30	29	96.6667 %
SKIN ALLERGY	20	17	85%

Fig 1.10 Percentage of accuracy values for KNN

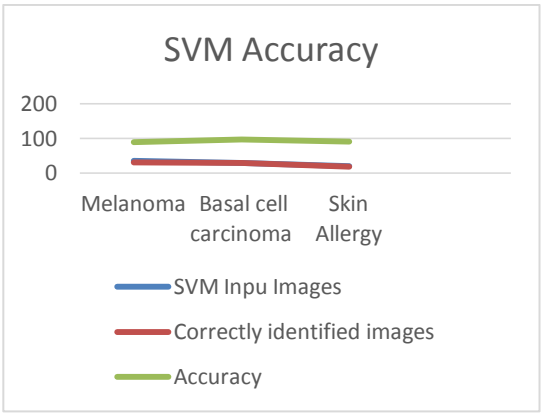


Fig.1.11 Comparison Graph of SVM accuracy

TYPES	KNN Input images	Correctly Identified images	Accuracy
MELANOMA	35	29	82.85714%
BASAL CELL CARCINOMA	30	25	83.33333%
SKIN ALLERGY	20	16	80%

Fig 1.12 Percentage of accuracy values for KNN

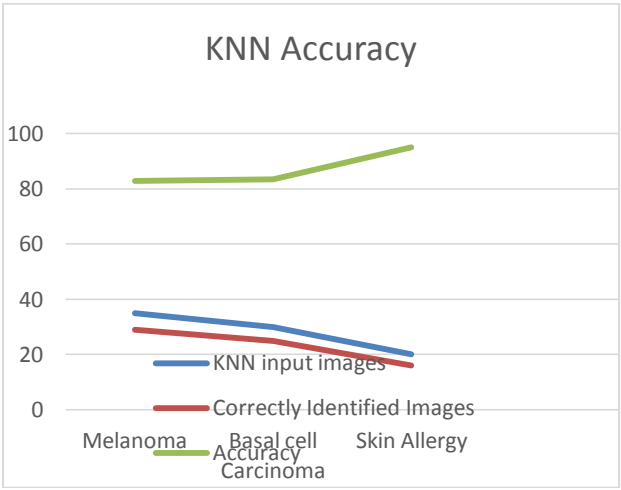


Fig 1.13 Percentage of accuracy values for KNN

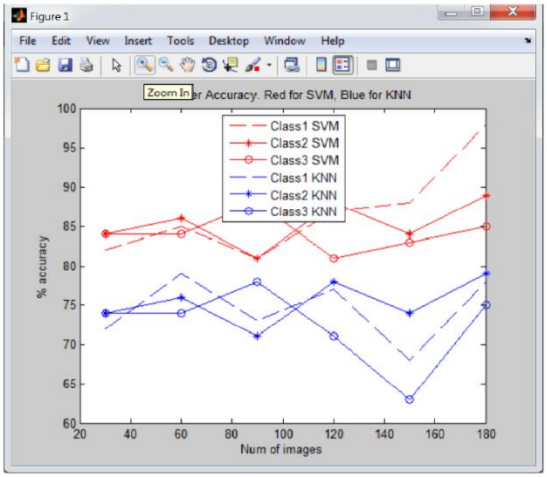


Fig 1.14 Comparison graph for SVM and KNN Classifier

Above graph shows that performance of proposed method of SVM is compared with the KNN based method which shows the SVM have better performance result than the KNN classifier.

C) Comparison between FCM and DWT Segmentation methods:

For the better performance the FCM segmentation technique is compared with the DWT technique. The performance parameters used are MSE, PSNR and Accuracy.

1) MSE:

MSE	
FCM	DWT
0.6141	2.09E+04
0.5798	2.6874e+004
0.2541	3.26E+04
0.1358	3.84E+04

Fig 1.15 MSE values for FCM and DWT

Fig.1.16 Graph for MSE

As shown in above fig FCM have low error rate i.e zero error rate which is calculated by using the above formula.

2) PSNR:

PSNR	
FCM	DWT
50.2827	4.9587
50.532	3.8715
54.1144	3.0372
56.8357	2.3171

Fig 1.17 PSNR values for FCM and DWT

Fig 1.18 Graph for PSNR

As shown in above fig FCM has better PSNR rates than the DWT

3) Accuracy:

Accuracy	
FCM	DWT
71.846	69.2308
54.5105	69.2308
94.2245	69.2308
64.4806	69.2308

Fig 1.19 Accuracy values for FCM and DWT

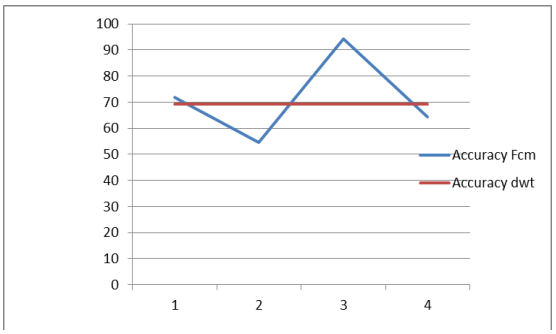


Fig 1.20 Graph for accuracy between FCM and DWT

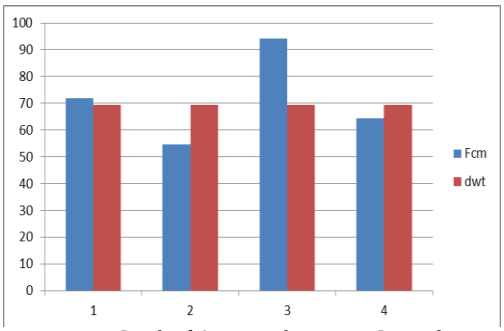


Fig 1.21 Bar Graph of Accuracy between FCM and DWT

Accuracy of FCM segmentation technique is better as compared to DWT technique. Bar graph for accuracy is as shown in above fig.

VII. CONCLUSION

This paper presents the automated detection of skin cancer and skin allergy. Here automated detection is done by Fuzzy c means segmentation i.e the affected portion is detached from healthy i.e normal skin. The unique textural features of the segmented images were pull out by using GLCM. The percentage area for the affected skin is calculated. SVM is used to classify whether the infection of the skin is a type of cancer or a simple allergy. The performance of proposed method of FCM segmentation is compared with DWT based method in terms of PSNR and MSE. And the results of FCM give better performance as compared to DWT. Also the performance of proposed method of SVM classification is compared with KNN method. And SVM gives better performance results as compared to KNN results.

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