System for Detection and Classification of Acne

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Abstract : Acne is a popular inveterate skin condition that involves blockage and / or inflammation of the hair follicles and accompanying sebaceous glands. Acne can appear as a non-inflammatory lesion, inflammatory lesions, or a blend of both, influencing for most part of the face yet in addition the rear and chest. Distinguishing the various sorts of skin break out injuries is significant in both diagnosis and management. As indicated by skin inflammation face mapping, nearness of skin inflammation in different pieces of the face or body has various signs for malady. Acne is a skin ailment that affects the sebaceous glands in cases of inflammation or infection. It influences 85% of grown-ups eventually amid their lives. To evaluate zits, doctors and dermatologists use methods such as simple photo flash and direct visual appraisal. Sometimes these techniques can be tedious. This project includes the classification of various types of zits such as

a. Acne cystic b. Acne Excoriated c. Acne Pustular

Index Terms – **Acne detection, Acne types, Image Processing**

I. INTRODUCTION

Acne is a skin disease that generally manifests itself in red skin with infections and breakouts on normal skin. This often occurs in the human face, but can appear throughout the body. It tends to be in any shape yet the most normal shape is roundabout with different shading (red, dark, white) relies upon a reason and stage. This can be caused by skin infections with bacteria and penetrates into the sebaceous glands under the skin, which leads to inflammation of the pimples in that tainted area. On the other hand, acne does not have to be formed by bacteria, so it cannot be heated and is a cause of sebaceous obstruction.

Reasons for acne: There are several foundations for acne, including genetic, hormonal, fat, bacterial, climate, chemical and psychological causes. A portion of the particular causes are as per the following..

• Foods with high glycemic components such as rice, deserts, bread, and pasta are associated with causes of acne. To avoid acne and stay healthy overall, a balanced and a healthy diet can avert zits.

• If the two guardians had acne, three out of four kids will have acne.

• If one parent had skin inflammation, at that point one out of four kids will have skin inflammation.

•However, like other hereditary conditions, only one out of every odd family will have a similar example.

Motivation:

To ensure accurate care, it is very difficult to manually analyze the condition and pattern of acne, which is very impractical. To overcome this problem, as of late analysts have proposed computational imaging techniques for skin inflammation determination. The region of research that underpins its analysis is Image Processing. At present there are 1000’s of beauty clinics all through the world, and especially people in the age bunches somewhere in the range of 12 and 26 are exceedingly experienced assortment of skin break out conditions. In acne treatment, dermatologists analyze skin break out amount and seriousness by manual tallying and ordering into following sore sorts: blackheads, pustules, papule, nodules and cysts etc. Dermatologist needs to stamp the spot of skin inflammation on the sheet to demonstrate skin break out's area and check them physically. This method has a high level of distrust, inaccuracy and requires specialist's intemperate exertion. Therefore, a computerized acne detection image processing system has been proposed to overcome manual counting.

Objectives:

1.To develop and apply an enhanced approach to acne segmentation using the adaptive threshold approach by prioritizing contrast images.

2. To segment the acne model from the acne face image using fuzzy C-means clustering technique, using an adaptive core and creating a mask for all training images.

3. To extricate 14 Haralick features from all models extracted in a mask to uniquely describe the type of acne.

4. Classification of Extracted features Using Naïve Bayes Classifier in level 1 and Level 2 and furthermore give the relative outcome Using Linear Discriminator Analyzers.

5. Integrate all the protocols above into a user-friendly interface and ensure decent client experience.

II. LITERATURE REVIEW

Image processing techniques available to detect acne:

Automatic acne detection using binary thresholds [1]

In this work, a typical cheek image is used to carry out experiments that automatically mark zits. The input image is first converted to gray, and certain color samples are considered to identify areas of interest. The binary threshold is then used to clearly indicate the acne area.

Surveillance: Focuses only on segmentation and only pictures of cheeks are accepted as experiments, and thresholds usually cannot handle noisy or low-light images, which are ignored in this work.

Automatic Acne lesion Detection Program [2]

The condition for optimizing the nature of acne lesions was developed as a counting program. Almost 25 volunteers with acne lesions were included in this work for experimental purposes. Automatic lesion counts for five acne subtypes (pustules, nodules, papules, blackheads and white heads) were performed by image processing. The Automatic Disability Reporting Program utility was assessed by comparing it with the number of manuals made by knowledgeable dermatologists using the results of the programs developed. Compared to manual counting, findings using the lesion calculation program are associated with papules, nodules, pustules, and whiteheads, providing 90% accuracy.

Perception: Accuracy can be additionaly improved. Certain types of zits can be focused, and the scope also includes facial images and other types.

Acne detection using convolutional neural network [3]

In this technique, drawing image features is based on CNN and classification is carried out by classifiers. Binary classifier of skin and non-skin is utilized to recognize skin area, and seven classifiers are used to accomplish the task of classification of facial vulgaris acne and healthy skin. In the tests, comparision on the adequacy of CNN and the VGG16 neural system which is pre-prepared on the ImageNet informational index is completed.The ROC curve is used to assess the performance of the binary classifier and to use a normalized confusion matrix to evaluate the performance of seven classifiers. The aftereffects of examinations demonstrate that the pre-prepared VGG16 neural system is successful in removing highlights from facial skin break out vulgaris pictures. And its properties are very valuable for the subsequent classifiers. Finally, we tried applying classifiers based on nerve VGG16 networks that were made previously to help doctors diagnose the person.

Acne assessment from smart phone images [4]

The mobile application utilizes a camera to take front face image of a subject. Furthermore, the images taken are spatially calibrated based on reliable points such as the position of the iris. Face recognition algorithms are used to identify facial features of a human face, normalize images, and identify areas of interest (ROI) to assess acne. We recognize acne lesions and classified them into two categories: pustules and papules. Automatic assessment of facial acne was approved by testing images from 60 advanced human models and 10 genuine human face pictures. This application can identify 92% of acne lesions in five aspects of ROI. The order exactness for isolating papules from pustules was 98%. In combination with documentation of care, lifestyle factors and automatic assessment of facial acne, this application can be utilized in cosmetic and clinical dermatology. It enables clients to quantitatively self-measure skin inflammation seriousness and treatment viability on a progressing premise to enable them to deal with their acne.

A facial pore aided detection system using CNN [5]

The convolutional neural network systems (CNN) approach to the facial pore detection system has been developed. The LeNet-5 model is used as a standard architecture and checks the performance of various depth networks in our face-pore dataset. The facial pore supported recognition framework will help individuals see progressively about their facial skin issues and appropriately keep their facial skin well.

Scar detection for assessing treatment [6]

A strategy is contrived to take care of the issue of recognizing the scar, size of the scar, discover the level of burn or sickness mapping the redness of the scar and finding the quantity of bunches of scars in a picture simply by utilizing image processing methods. The strategy had given practically 90% precision.

Image analysis model for detecting skin diseases: Frame [7]

This work intends to identify skin ailment from the skin picture and to break down this picture by applying channel to expel commotion or undesirable things, convert the picture to grey to help in the handling and obtain the valuable data. This helps prove all types of skin diseases and describes emergency orientation. The results of the analysis of this study can help doctors to help with the initial diagnosis and know the nature of the disease. It is skin friendly and avoids side effects.

Acne detection using speeded up robust features and k-nearest neighbors [8]

This document contains an acne detection technique that uses speeded up robust features and then classified utilizing five technical features: standard Deviation of red(SD),SD of green , ,SD of Blue , Blue, hue mean and Circularity. Quantification using the K-Nearest Neighbors (KNN) algorithm was also evaluated. The outcome was 68% accuracy with a sensitivity of 73% and an average accuracy of 84%.

Skin disease detection model using image processing [9]

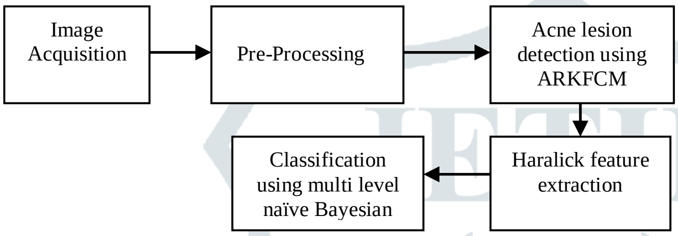
This technique is mobile and very affordable even in remote areas and is completely non-invasive on the patient's skin. The patient gives a picture of the contaminated zone of the skin as a contribution to the model. Image processing techniques are performed on this picture and the identified ailment is shown at the yield. The proposed framework is helpful in country territories where access to dermatologists is constrained.

Classification of Acne lesion [10]

In this article, we introduce you to various methods for image segmentation to detect acne lesions and machine learning methods that distinguish between various types of acne lesions. Our outcomes exemplified that among s texture analysis, k-means grouping, HSV model division systems, two level k-means clustering outflanked the others with an exactness of about 70%.Moreover, the precision of separating acne scars from active inflammatory lesions is 80% and 66.6%, respectively, for fuzzy c means and support vector machine methods.

III. PROPOSED METHODOLOGY

The approach proposed for classification of types of acne is portrayed in the Figure 1, block diagram of classification of skin diseases.



A. Image Acquisition

Images are taken with the cell phone's camera and uploaded to our desktop application. First it is assumed that the input image is an RGB format. RGB (Red, Green and Blue) alludes to the color rendering system used on a computer screen. Red, green and blue can be joined in different proportions to maintain any color in the visible spectrum. Values for R, G and B can be between 0 and 100 percent of full intensity.

B. Pre- Processing

The purpose of pre-processing is an improvement of the image data that stifles undesirable contortions or upgrades some image features significant for further handling. Pre-processing is done by contrast adjustment or histogram equalization technique. Next, the image is attached to the Gaussian threshold to eliminate the typical false artifacts from the lighting attached to the image.

C. Acne lesion detection

In the proposed technique segmentation is carried out primarily by utilizing morphological opening operations along with the help of disc structuring element. Because the morphological opening process does not prompt palatable result regarding acne diseases, further segmentation is tested by adaptively regularized fuzzy C-means clustering.

D. Feature extraction

After the segmentation process, 14 features were extracted using haralick feature extraction method. Haralick Features are defined as functions of one or more measurements, each of which determine and calculate the quantitative property of an object to measure certain important features of that object. In our proposed methodology features were also extracted using GLDM method, but the accuracy we obtained after classifying them was less as compared with haralick feature extraction method.

E. Classification

After the feature extraction, classification process was carried out using Naïve bayes algorithm and also Linear Discriminant Analysis (LDA) technique. The accuracy we obtained using Naïve bayes algorithm was more as compared with the LDA technique.

PRE-PROCESSING

Histogram Equalization method:

Histogram equalization is an approach to adjust the intensity of an image to increase contrast. Let f be an image represented as a matrix m_r by m_c of integer pixels in the range 0 to L-1. L represents the number of possible intensity values, often 256. Normal histogram of f with bin for every possible intensity be denoted by p. Hence

$$p_n = \frac{\text{number of pixels with intensity } n}{\text{total number of pixels}} \qquad n = 0, 1, \ldots, L-1$$

The histogram equalized picture g will be characterized by

$$g_{i,j} = \text{floor}((L-1)\sum_{n=0}^{f_{i,j}} p_n),$$

where floor () rounds down to the closest number. This is the same as converting pixel intensity k in f of the function

$$T(k) = \text{floor}((L-1)\sum_{n=0}^{k} p_n)$$

SEGMENTATION:

Morphological opening:

In the mathematical morphology, the aperture is the level of erosion of set A of feature B:

$$A \circ B = (A \ominus B) \oplus B$$

Where '-'and '+' means erosion and dilation

Together with the closing, opening serves in computer vision and image processing as the main working console for removing morphological noise. Closing removes small holes in the foreground, changing little islands of background into forefront, while openings remove small objects from the foreground (usually bright pixels) of an image and then placing them in the background. These systems can likewise be utilized to discover explicit shapes in a picture. Opening allows you to find things that match certain structuring elements (edges, angles). In the proposed technique, the arrangement element with radius 5 is used. Because the morphological opening process does not prompt palatable result regarding acne diseases, further segmentation is tested by adaptively regularized fuzzy C-means clustering.

Adaptively Regularized Fuzzy C-Means (ARFCM) Clustering:

ARFCM utilizes neighborhood requirement property of picture pixels; a versatile weighted coefficient is acquainted into KFCM to control the impact of the neighborhood pixels to the focal pixel naturally. Finally, it is proposed to use the Fuzzy Cluster Partition Rules, which can identify the best cluster partition numbers and provide a basis for optimizing clustering algorithms. To improve image segmentation performance, kernel-based Fuzzy C Means Clustering adapted to spatial constraints (AKFCMS) is proposed for image segmentation approaches. The ability to adapt to the local context, preservation of image detail with increased consistency, independence of cluster parameters and reduction in calculation costs are the main advantages.

FEATURE EXTRACTION

Haralick feature extraction method:

Haralick properties are calculated using the gray level matching matrix characteristics. The basis of these properties is the G matrix of gray level simultaneous events in the equation below. This matrix is the square of the size of Ng, where Ng is the number of gray levels in the image. The matrix element [i, j] is generated by counting the number of times the pixel with i borders the pixel with the value j, and then divides the entire matrix by the total number of the comparison. Therefore, each record is considered as the probability that a pixel with i is discovered adjoining a pixel with a value of j.

$$\mathbf{G} = \begin{bmatrix} p(1,1) & p(1,2) & \cdots & p(1,N_g) \\ p(2,1) & p(2,2) & \cdots & p(2,N_g) \\ \vdots & \vdots & \ddots & \vdots \\ p(N_g,1) & p(N_g,2) & \cdots & p(N_g,N_g) \end{bmatrix}$$

Because the environment can be characterized to occur in one of four directions in 2D, square pixel images (vertical, horizontal, right and left diagonal - see Figure 3.1), these four matrices can be calculated.

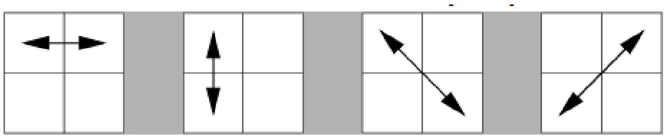


Figure 3.1: Four directions of adjacency as characterized for estimation of the Haralick texture Properties.

Haralick statistics are calculated for the matrix of shared events produced by each direction of this environment. 14 Haralick's functions derived from the picture are shown in Figure 3.2.

Angular Second Moment	$\sum_i \sum_j p(i,j)^2$
Contrast	$\sum_{n=0}^{N_g-1} n^2 \{\sum_{i=1}^{N_g} \sum_{j=1}^{N_g} p(i,j)\}, \lvert i-j \rvert = n$
Correlation	$\frac{\sum_i \sum_j (ij)p(i,j) - \mu_x \mu_y}{\sigma_x \sigma_y}$ where μ_x , μ_y , σ_x , and σ_y are the means and std. deviations of p_x and p_y , the partial probability density functions
Sum of Squares: Variance	$\sum_i \sum_j (i-\mu)^2 p(i,j)$
Inverse Difference Moment	$\sum_i \sum_j \frac{1}{1+(i-j)^2} p(i,j)$
Sum Average	$\sum_{i=2}^{2N_g} i p_{x+y}(i)$ where x and y are the coordinates (row and column) of an entry in the co-occurrence matrix, and $p_{x+y}(i)$ is the probability of co-occurrence matrix coordinates summing to $x+y$
Sum Variance	$\sum_{i=2}^{2N_g} (i - f_8)^2 p_{x+y}(i)$
Sum Entropy	$-\sum_{i=2}^{2N_g} p_{x+y}(i) \log\{p_{x+y}(i)\} = f_8$
Entropy	$-\sum_i \sum_j p(i,j) log(p(i,j))$
Difference Variance	$\sum_{i=0}^{N_g-1} i^2 p_{x-y}(i)$
Difference Entropy	$-\sum_{i=0}^{N_g-1} p_{x-y}(i) \log\{p_{x-y}(i)\}$
Info. Measure of Correlation 1	$\frac{HXY-HXY1}{\max\{HX,HY\}}$
Info. Measure of Correlation 2	$(1-\exp[-2(HXY2-HXY)])^{\frac{1}{2}}$ where $HXY = -\sum_i \sum_j p(i,j) \log(p(i,j))$, HX , HY are the entropies of p_x and p_y , $HXY1 = -\sum_i \sum_j p(i,j) \log\{p_x(i)p_y(j)\} HXY2 = -\sum_i \sum_j p_x(i)p_y(j) \log\{p_x(i)p_y(j)\}$
Max. Correlation Coeff.	Square root of the second largest eigenvalue of $\mathbf{Q}$ where $\mathbf{Q}(i,j) = \sum_k \frac{p(i,k)p(j,k)}{p_x(i)p_y(k)}$

Figure 3.2: 14 Haralick features and their meanings

Gray level difference method (GLDM):

GLDM computes the function of the probability density method for the gray scale of an image. This method is usually utilized for obtaining statistical texture features from gray scale images. Gray scale texture alludes to the appearance, texture, and arrangement of parts of objects in the image. Attribute values are real numbers that encode discriminatory object property information. It may not always be clear what information or features are useful for certain recognition tasks. The roughness of the texture or thinness of the image can be interpreted as the distribution of elements in the matrix, such as GLDM. The texture analysis matrix itself does not directly provide a single feature by which the texture can be distinguished. Rather, the matrix can be utilized as a texture rendering scheme, and the property is calculated by the texture discrimination matrix. GLDM is based on the appearance of two pixels which have absolute differences in gray levels and which are separated by certain displacement is δ . For each displacement vector given.

$$\delta = (\Delta i, \Delta j)$$
$$S(i,j) = \lvert S(i,j) - S(i+\Delta i, j+\Delta j) \rvert$$

and the probability density function is estimated to be determined by

$$(i \mid \delta) = prob(S_o(i,j) = 1)$$

CLASSIFICATION

Naïve Bayesian classifier in multiple levels:

The proposed method uses Bayesian naivety to hierarchically classify data from three classes. The two-step classification is carried out at each level by assuming the data sets with respect to one versus many classifications. This can also improve classification performance. Figure 3.3 shows the model used to classify data sets.

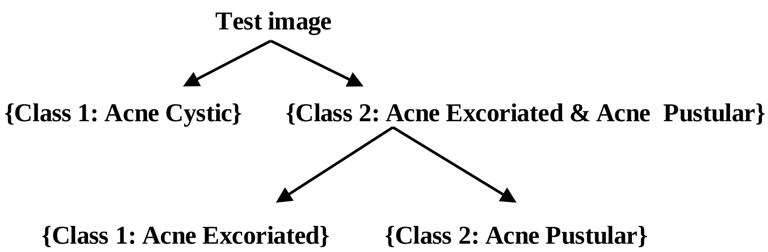


Figure 3.2: Hierarchical Model of Classification

At each level, the Naïve Bayes classifier is used to classify test images.

Bayesian theorem is a classification technique with an assumption that the predictor is independent. Simply put, the Naive bayes classifier assumes that the presence of features in one class is not related to the existence of other features. These features depend on one another or upon the presence of other characteristics. All of these properties contribute independently to test images belonging to a particular class and are therefore called "naive".

The Naive Bayes model is easy to construct and is perfect for very large data sets. Besides simplicity, Naive Bayes has been known to outperform even the most complex classification techniques.

With the Bayes theorem, the posterior probability P (c | x) can be calculated from P (c), P (x) and P (x | c). See the following equation:

$$P(c|x) = \frac{P(x|c)P(c)}{P(x)}$$

$$P(c|x) = P(x_1|c) \times P(x_2|c) \times ... \times P(x_n|c) \times P(c)$$

Here P (c | x) is the posterior probability of class (c, target) of a predictor (x, attribute).

P (x | c) is the probability that a class is predicted.

P (c) is the prior probability of a class.

P (x) is the prior probability of predictor.

Linear Discriminant Analyzer (LDA)

In the proposed method, LDA is also used to classify test sets to compare the performance of multi-level classification techniques with direct classification in n classes at one level.

Linear Discrimination Analysis (LDA) is a typical system utilized for classification supervised problems

CONCLUSION

In this proposed methodology we were able to implement and develop a system for detection and classification of acne utilizing an adaptive thresholding approach by enhancing the contrast of the image using histogram equalization method. Further we performed segmentation process using both morphological opening as well as ARKFCM method and the accuracy we obtained in ARKFCM method was comparatively more than morphological opening technique. Finally we extracted and classified the test images using haralick feature extraction and Naïve bayes algorithm. The accuracy we obtained using these methods was 91.2%.Our proposed approach gives more effective and accurate results.

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