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DETECTION OF DEFECTS IN DENTAL WITH SUPPORT VECTOR MACHINE (SVM) USING IMAGE PROCESSING

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ABSTRACT

The process of dental defect analysis is to provide an efficient clinical support with less complexity in segmentation, better accuracy in foreground object detection and to provide local contrast and luminance invariant features using the various descriptors. The automatic decision support system includes adaptive threshold and support vector machine for dental disease prediction. The proposed segmentation approach, adaptive threshold is used to segment significant information from input image for extracting features. An adaptive threshold is determined based on pixel probability and variances. In feature extraction stage, segmented region will be used to extract features which describes about color and texture contents. The color features are extracted from HSV color space of selected region based on histogram analysis. Weber's local descriptor (WLD) represents an image in terms of histogram features which are extracted from gradient orientation of an input. Discriminative Robust Local Ternary Pattern (DRLTP) based histogram features are used to differentiate the local object in terms of contrast, shape and illumination changes. Combined Color and texture features are used for SVM training with reference samples for its classification. SVM (Support Vector Machine) is the supervised learning model used to classify and identify the test dental image into either normal or abnormal defects based on supervised training with the radial basis kernel function. Finally the simulated result shows that utilized methodologies thereby providing better performance and good classification accuracy rather than prior methods and the identification of dental defects.

Index Terms— Adaptive thresholding, pixel probability, variance, HSV color space, Weber's local descriptor(WLD), Discriminative robust local ternary pattern(DRLTP), histogram features, Support vector machine (SVM).

I. INTRODUCTION

Automated dental identification system (ADIS) was developed for extraction of the distinctive features of tooth images. They were then compared with the reference images, hence detecting the defect in the tooth image. The main process is to identify the defect using the features collected with the help of the automated dental identification system, carried out with a specialized and advanced classification machine known as the Support Vector Machine. Hence, we consider the following modules in order to perform an efficient processing of defect detection and are Image segmentation, feature extraction and SVM classifier. The most important fact of SVM classifier is that it possesses two different phases such as, training and a testing phase. The SVM classifier is being initially trained with the features of the reference samples. Hence, the testing phase performs the comparison for the best match with the reference features and classifies its defective features. Therefore, an accurate and a less complex identification of the defect are being enhanced using the SVM classifier.

II. RELATED PREVIOUS WORK

Automated decision support system acts as the basis for the dental defect prediction and is used to extract the efficient and the related features of human teeth using MATLAB.

Hong Chen and Carol Novak

[1] focuses on the features and dental work using various methods for segmentation to provide a best match for the human identification. Whereas, they failed to provide better classification of dental work. Anita Patel and Prithish Patel

[2]developed an automated dental identification system for human identification during post-mortem with the ante-mortem radiograph based on some features and characteristics. Poor quality of images, teeth overlap, and teeth shape change consideration due to aging were not considered. N.P.Ansingakar

[3] provided negative image creation contrast sketching and histogram equalization using different point operating techniques. Unable to differentiate several areas of the image that requires different levels of contrast enhancement. Kathirvelu and Aqsa Ajazl

[4]worked together to develop the code extracted from the features using algorithms. These dental features play their role in identification. High complexity and less accurate classification and complexity in feature extraction for certain images. Samir Shah, Arun and Ayman Abaza [5]worked with multiple results to identify similarities and differences in the image. The contour value of each tooth is estimated even if there is no well defined image with some noise. Accuracy is reduced in large scale dental identifications.

III. OUR NEW APPROACH

We propose, to systematically develop a system to represent the defect in dental that would help doctors to easily identify the dental abnormalities. Here the image gets processed indicating whether the scanned teeth image is free from decays or other defects. A desired conclusion for the patient is obtained in a short duration; so that the procedure for the treatment can be carried further by the dentist.

IV. FRAMEWORK MODEL FOR DEFECT ANALYSIS

The process and the various stages involved in the detection of the teeth defect is shown in fig1. Initially, the input image given to the system is provided to the preprocessing stage, where the image undergoes two important changes namely, Dimensionality reduction and the smoothening process. During the dimensionality reduction the reshapening of the input image occurs, which generates the gray image for the input teeth image. The gray image undergoes smoothening process, with the use of the special filters namely the Gaussian filter, which purpose is similar to that of the low pass filters (LPF). Hence the smoothened image thus obtained undergoes image segmentation.

The Image segmentation is a process of partitioning an image into nonintersecting regions such that each region is homogeneous. Here Adaptive thresholding method is used. It is a simplest and standard method for automatic threshold selection which overcomes the problem of existing algorithms. It is used to measure the average foreground and background variance to suppress the redundant region to zero's and set one's to desired foreground. It is used to obtain an optimal threshold that maximizes a function of the threshold level. This probability based image segmentation is helpful to extract the hybrid features from the segmented region.

In feature extraction phase, the segmented region will be used to extract features which describes about color and texture contents. The color features are extracted from HSV color space of selected region based on histogram analysis. WLD and DRLTP are texture descriptors used to characterize the local texture of object. WLD represents an image in terms of histogram features which are extracted from gradient orientation of an input. DRLTP based histogram features are used to differentiate the local object in terms of contrast, shape and illumination changes. Combined Color and texture features are used for SVM training with reference samples and its classification.

Here, supervised learning with non knowledge based classifier will be used for image classification. The Learning machine type, SVM (Support Vector Machine) is used here to act as a classifier with radial basis function as a kernel function. The SVM contains two important phases namely the training phase and the testing phase. Where the SVM is well trained with the features obtained from the reference samples during the training phase of the SVM.

Training sampled feature vectors and its group values are determined before the training of SVM classifier. The training samples features with assigned target vectors are fed into created SVM model for supervised training to get information about the trained classifier including support vectors. Finally, test image features are simulating with trained SVM Classifier to make decision of dental image and the detection of the defect.

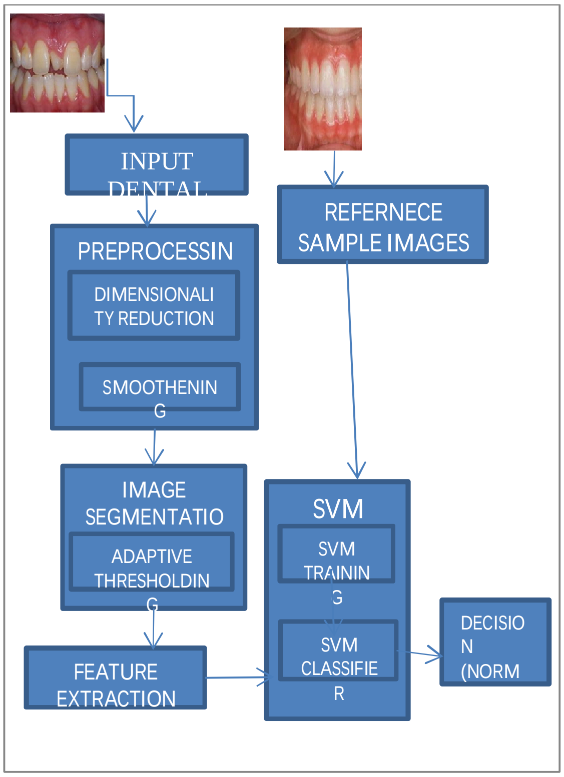


Fig1. An overview layout for dental defect analysis.

A. PREPROCESSING

The input image will be initially preprocessed by means of dimensionality reduction and by the smoothening processes. The dimensionality reduction uses the algorithm known as the Principle Component Analysis (PCA). Where PCA is used for two various purposes i.e., for dimensionality reduction and feature extraction, but the efficiency of PCA is less in feature extraction hence it plays its major role in dimensionality reduction. Initially, any 2D input image in RGB format is of m*n*3, where m and n represents the rows and the columns containing different pixels and 3 represents the RGB pattern. Hence, PCA processes these 2D formatted RGB image into a 1D pattern, such that represented in the form of 65536*3 matrix format. Therefore, the covariance, the Eigen values and the Eigen vectors are determined for the matrix 65536*3. The largest Eigen value and its corresponding Eigen vector are considered say 65536*1 matrixes are obtained. Hence, the 1D matrix is now reshaped into 2D pattern which contains 256*256 pixels. Since only the largest Eigen values and vectors are chosen the RGB image is thus converted to obtain a gray image.

RGB IMAGE

GRAY IMAGE

The gray image thus obtained as a result of dimensionality reduction is smoothened using the Gaussian filter. The gray image i.e. the Dimensionality reduced image undergoes convolution (Image Smoothening) in order to obtain an smoothened image of 3*3 matrix.

$$Gauss\ Coeff = \left(\left(\frac{1}{\sqrt{2*\pi*\sigma^2}}\right)\left(exp^{\left(-\left(\frac{x^2+y^2}{2*\sigma^2}\right)\right)}\right)\right)$$

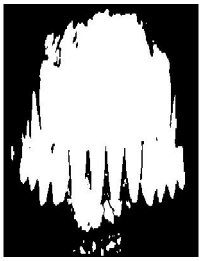
The above shown equation acts as the Gaussian filter where, XY are the coordinates, and sig represents the standard deviation.

B. IMAGE SEGEMENTATION

Thus, the preprocessed image undergoes image segmentation process. Segmentation problems are the bottle neck to achieve the objects extraction ,object specific requirements and fast object rendering from the multi dimensional image data. It uses an algorithm known as Adaptive Thresholding. Using adaptive thresholding, the smoothened 256*256 pixel image is converted into a binary image in order to segregate the background region form the target region. The histogram and its probability for the preprocessed image is obtained. Where histogram is plotting of the intensities of the image in an XY plane using an discrete representation. The discrete lines are known as the Bins. Hence histogram is simply called as a “Collection Of Bins”. Hence the total number of occurrence at each intensity known as the “Counts” are taken and probability of intensity is being calculated using the below equation,

$$p(0) = \frac{n(0)}{nT}, \ldots\ldots\ldots\ldots \quad p(256) = \frac{n(256)}{nT}$$

Where nT represents the total number of pixels i.e. 65536.



BINARY IMAGE

RGB IMAGE

The histogram and the number of occurrences of the intensity is shown in fig2.

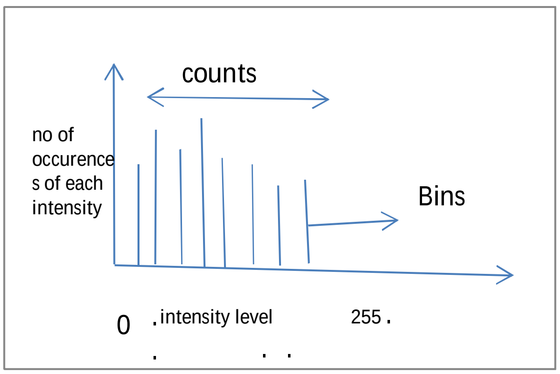


Fig2. Histogram representation for preprocessed image

In order to obtain the foreground from the background region the fixation of the target value is important and the following are calculated for both the regions to determine the target value i.e. class probability, mean class probability and the class variance. The Threshold value and interval range are shown in the fig3.

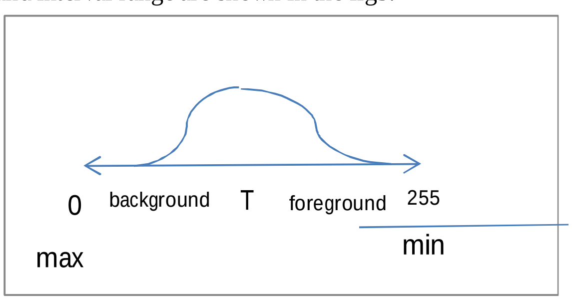


Fig3. Threshold value and interval range

Hence the class variance calculated for both the background (between interclass variance) and the foreground (within intra class variance) and hence the needed variance is selected. Using the selected value of the variance the target value is calculated and hence a comparison is done between the Pij and the target (T) value. If the value of Pij is less than T then it corresponds to the background region and if Pij is greater than the T value then it is represented as the foreground region. Hence the foreground region is separated from the background region using adaptive thresholding method.

C. FEATURE EXTRACTION

The segmented portion of the dental image obtained using adaptive threshold undergoes feature extraction processes. In this process the features such as the color and the texture of the image are being focused. Hence, we consider the color histogram process for the extraction of the color related features. . Each image added to the collection is analyzed to compute a color histogram, which shows the proportion of pixels of each color within the image. The color histogram for each image is then stored in the database .The color histogram considers the RGB image and converts them into an HSV pattern. Where the H represents the Hue, S represents the Saturation and V represents the Value. The color features are obtained by plotting the image histogram for hue and saturation, where the number of counts provides the color features. The counts related to the number of occurrences are considered such that the features are obtained. The value of the color features thus obtained using the histogram is being stored. The histogram for the color features are shown in fig4.

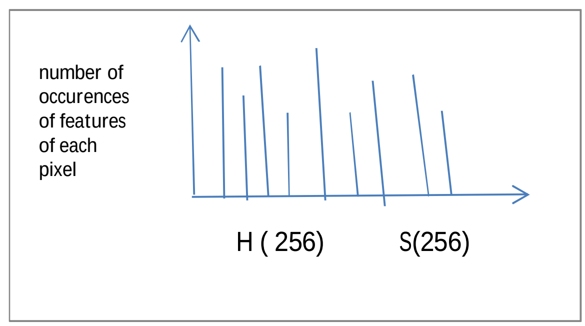


Fig4. Hue(H) and Saturation(S) features extraction.

The texture features are obtained using the texture descriptors; hence here two important descriptors are being considered namely WLD (Weber's local descriptor) and DRLTP (Discriminative robust local ternary pattern). The WLD and DRLTP are the two descriptors used to characterize the local texture of the object.

The WLD mainly represents the orientation and the differential excitation of the object. It represents the image into 3*3 matrix pattern and identifies the differential excitation and the orientation of the image. Using these excitation the gradient magnitude and orientation for the image is calculated using the formulas. Finally, the histogram is being developed for the orientation features obtained using WLD. Relating to the number of occurrences and its excitation features, counts are being obtained which represents the value for the WLD. Similarly, the DRLTP is used to differentiate the image based on contrast, shape and the illumination changes. In this descriptor the image obtained as 3*3 matrix used to develop the LTP(Local ternary pattern) codes. The RLTP (Robust LTP) is obtained using the values of LTP and histogram. The gradient magnitude is obtained and the histogram is finally being built for the entire DRLTP. Hence the values obtained from DRLTP, WLD and the color feature histograms totally together constitute the feature of an image.

D. SUPPORT VECTOR MACHINE (SVM) CLASSIFIER

The Support vector machine is the combination of the training samples and the desired output. Supervised learning with non knowledge based classifier will be used for image classification. The SVM provides an accurate classification of the image. The SVM contains two phases namely the training phase and the SVM classification phase.

The SVM training phase constitutes the training of the SVM with the desired features and the corresponding related output. The process similar to the feature extraction is performed in order to train the SVM with the features. Secondly, the SVM classifier phase represents decision making process, where the features of the trained sample are compared with the features of the input image. The SVM trained with reference features set and desired output using “svm train” command. Here, target 1 for normal and 2 for each abnormal case are taken as desired output. After the training ,updated training factor and biases with other network parameters are stored to simulate with input features .At the classification stage, test image features are utilized to stimulate with trained with SVM model using “svm classify” command .Based on these commands the input dental image is being classified. Hence the defect related to the input image is analyzed for the future treatments. The performance of the SVM classifier can be evaluated by these parameters namely sensitivity, specificity and accuracy. Sensitivity (also called the true positive rate) measures the proportion of actual positives which are correctly identified and is complementary to the false negative rate. Specificity (sometimes called the true negative rate) measures the proportion of negatives which are correctly identified as such (e.g., the percentage of a healthy people who are correctly identified as not having the condition) and is complementary to the false negative rate. Accuracy represents the degree to which the result of a measurement, calculation, or specification conforms to the correct values or a standard.

V. CONCLUSION

This paper discussed about the different enhanced techniques to analyze the dental defects using the MATLAB. It provides better foreground object detection with low complexity in image segmentation. Here the descriptors WLD and DRLTP provide local contrast and the luminance invariant features. Better classification accuracy is obtained through Support vector machine (SVM) classifier.

VI. REFERENCES

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