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EVALUATION OF COMBINED FEATURES-BASED CLASSIFICATION IN ORAL LICHEN PLANUS USING GMM

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ABSTRACT

Oral Lichen Planus (OLP) are the most common oral cavity lesions that can progress to cancer. The only reliable method to diagnose such diseases is microscopic examination of tissue samples.The proposed method analyses the performance of pattern classification techniques such as Gaussian Mixture Model (GMM) to classify oral precancerous images, using features that have significant characteristics associated with the oral disorders. Histogram features are extracted from OLP images. GMM is used to classify the images into normal and OLP affected categories.Classification results show an accuracy of nearly 95% for all these models. The classification performance using GMM is analyzed.

Keywords Feature extraction, Histogram, Image classification, GMM

1.INTRODUCTION

Oral Lichen Planus (OLP) is a chronic inflammatory disease of unknown etiology . Application of computer aided diagnosis in the analysis and classification of oral cancer and precancerous lesions could overcome the difficulties of subjective variations and minimize the effort and time taken for diagnosis by oncologists. Oral lichen planus presents as white striations, white papules, white plaques, erythema, erosions or blisters affecting predominantly the buccal mucosa, tongue and gingivae, although other sites are occasionally involved. Oral lichen planus affects 1-2 per cent of the general adult population and is the most common non-infectious oral mucosal disease. Oral lichen planus affects women more than men (1.4:1). Oral lichen planus occurs predominantly in adults over 40, although younger adults and children may be affected. Lesions are typically bilateral and often appear as a mixture of clinical subtypes. White or grey streaks may form a linear or reticular pattern on an erythematous background.

Fig.1 shows the white linear pattern of the OLP lesion in the affected patient's oral mucosa. Oral lichen planus presents as white striations, white papules, white plaques, erythema, erosions or blisters affecting predominantly the buccal

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mucosa, tongue and gingivae, although other sites are occasionally involved. Lesions are typically bilateral and often appear as a mixture of clinical subtypes. White or grey streaks may form a linear or reticular pattern on an erythematous background. Alternatively, there may be a central area of shallow ulceration (erosion) with a yellowish surface (fibrinous exudate) surrounded by an area of erythema. OLP can present itself as any of the following forms- ulcer, plaque. Patch, erosion, papules, etc. Almost all cases of OLP present with reticular keratotic [white] striae in some area of the oral mucosa.

Fig.2(a) :Lichen Planus of cheek mucosa

Fig.2(b): Lichen Planus of tongue

Fig.2 (c): Lichen Planus of Gingiva (gums)

Microscopic Features

Basal cell liquefaction
Band-like
Lymphocytic infiltrate at epithelial – stromal junction with obfuscation of basal cell region
Normal epithelial maturation pattern
Candle- dripping spindy rete ridges
Parakeratosis
Civatte bodies
Ragged separation of epithelium from lamina propria due to cell destruction
Degeneration of the basal keratinocytes and disruption of the anchoring elements of the epithelial basement membrane and basal keratinocytes (eg, hemidesmosomes, filaments, fibrils) weakens the epithelial-connective tissue interface. As a result, histologic clefts (ie, Max- Joseph spaces) may form, and blisters on the oral mucosa (bullous lichen planus) may be seen at clinical examination. B cells and plasma cells are uncommon findings [1].

World Health Organization has defined OLP as a potentially precancerous disorder, representing a generalized state associated with a significantly increased risk of cancer. However, only 0.5 - 2.9% of OLP lesions will progress to cancer .The diagnosis of oral lichen planus demands expertise and experience in clinicians and pathologists. Like any other precancerous lesion, grading of dysplasia and assessment of its malignant potential is highly subjective, requiring more research work which is essential for a more appropriate diagnosis and classification of the disease

FEATURES FOR OLP CLASSIFICATION
Histogram and BICC feature extraction
Color histogram features as explained in Section 4.2 are extracted from both OLP affected and normal images. BICC features such as discussed in Section 5.2 are extracted from both OLP affected and normal images. The features are combined and normalized using equation (6.1) to produce a feature vector which characterizes the image.

$$y_i = \frac{(x_i - x_{\min})}{x_{\max} - x_{\min}} \quad (6.1)$$

where x_{max} and x_{min} are the maximum and the minimum values Xi of the un normalized data using Histogram features were extracted for 16, 32, 64 bins and BICC features were extracted for blocks of size 5 x 5, 10 x 10, 15 x 15 which resulted in 10, 45, 105 dimensional feature vectors respectively.

Fig.3 shows the OLP image with block 5 x 5 for extracting the BICC features. Fig. 6.6 shows the histogram features extracted from OLP image.

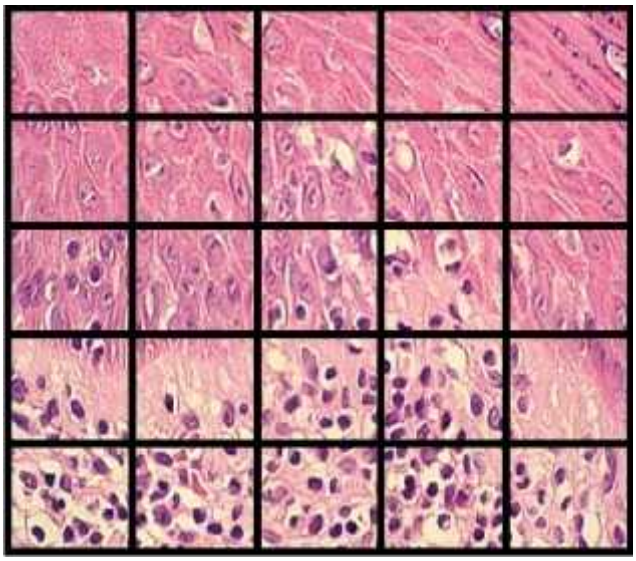

Fig. : OLP microscopic image is divided into blocks of size 5 X 5

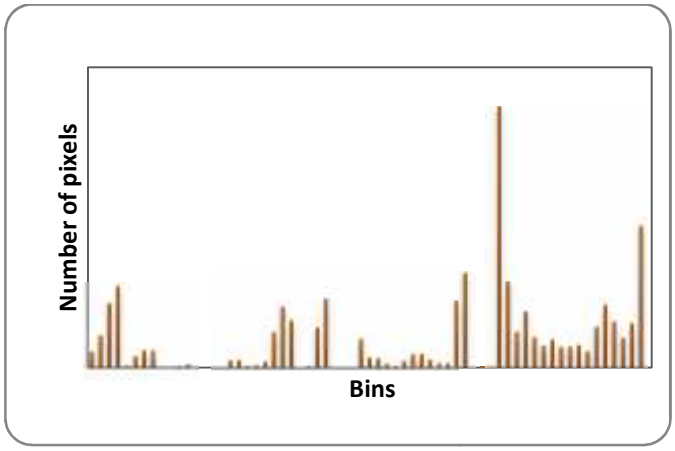

Fig: Histogram of OLP Microscopic Image

EXPERIMENTAL RESULTS

A total of 200 microscopic images which consists of 100 OLP images and 100 normal images are considered. For four fold cross validation training data gfi (i=1, 2, 3, 4) consisting of 150 microscopic images [50 images (25 Normal + 25 OLP) + 50 images (25 Normal + 25 OLP) + 50 images (25 Normal + 25 OLP)] are used. For testing, 50 microscopic images (25 Normal and 25 OLP) are used.

Evaluation using GMM

Gaussian Mixture Models are a type of density models comprises a number of components which are combined to provide a multimodel density. The performance of the system is studied for a mixture of Gaussians varying from 2 to 10. When the number of mixtures is less, the performance is low. The classification performance increases, as the number of mixtures increases.

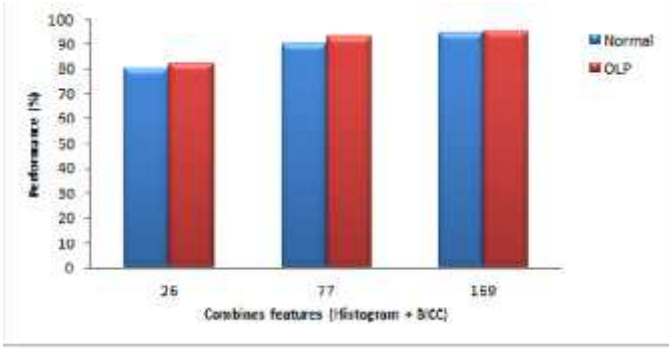

Fig.: Average performance of normal and OLP classification with different Bins by GMM model with 10 mixtures using combined features

The performance of OLP classification was studied using GMM for different mixtures. Expectation maximization algorithms were used to decide the parameters of the mixtures. Fig. shows the performance of OLP classification for 10 mixtures in GMM model with histogram, BICC and combined features respectively.

Table shows the performance of normal and OLP classification by GMM using coimbined features a maximum accuracy of 95% was achieved for 10 mixtures in this model

2.Discussion

Oral lichen planus, although has a lesser risk of malignant transformation as compared to ther PMDs, needs accurate diagnosis to rule other similar lesions of oral mucosa and also to plan for a proper treated. As an alternative to histopathological investigation, this research work has made an attempt to classify OLP images and normal mucosal images with the help of GMM by using histogram and BICC featureS extracted from the images used in the research work. An attempt was made to apply these combined features..

Experimental results show that the proposed OLP classification scheme is very effective with an accuracy rate of nearly and above 95.0 for above models.

3.Conclusion

Few other pattern classifiers such as SVM, AANN and others could also be applied in the same manner to classify other precancer and cancer images. This could bring out a better technique for oral lesion classification in the future.

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