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CLASSIFICATION OF LEUKOPLAKIA USING BICC FEATURES AND RBFNN

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ABSTRACT

Leukoplakia is the most common Potentially malignant disorder of the oral mucosa. Tobacco consumption has been found to be the main causative agent. Due to its high risk for malignant transformation, appropriate diagnosis and proper treatment planning become mandatory. Many other white lesions appearing in the oral mucosa resemble leukoplakia. Diagnosis by exclusion is preferred by the pathologists. As an alternative to routine histopathological investigation, image analysis techniques of extracted features from the lesional micosopic images can be done. These methods are already being experimented in OSMF and oral cancer. This research work is an attempt to classify leukoplakia images with the extracted BICC features using RBFNN pateern classifier.

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INTRODUCTION

Leukoplakia, meaning 'white patch' is the most common potentially malignant disorder (PMD) of the oral cavity. The diagnosis 'leukoplakia' is made clinically based on the appearance and it is confirmed only during microscopic evaluation of the tissue sections. Many other white lesions such as leukoedema, lichen planus, candidiasis, white sponge nevus, frictional keratosis, etc. should be excluded before arriving at the final diagnosis. Thus it is a diagnosis by 'exclusion' or elimination method. Buccal mucosa, tongue, gingival, palate, labial mucosa are the areas affected by the disease and among them buccal mucosa is more frequently affected zone. It is localised in distribution. Tobacco consumers, especially smokers are more prone for the disease. Any other form of irritation such as mechanical, chemical or galvanic means may also be causative. Homogenous and heterogenous are two clinical forms of leukoplakia differing in the pattern of distribution. The former is white throughout whereas the latter is mixed with red or erythematous areas (erythroplakia, which may occur as a separate entity also). These erythroplakic lesions are more potential for malignant transformation as compared to leukoplakia.the surface of the lesion may be smooth/ulcerated/nodular or erosive. Proliferative verrucous Leukoplakia, a separate variant has an alarming 80% cancer risk than the others. Leukoplakia located on the floor of the mouth and in the ventrolateral region of the tongue are associated with a greater risk of malignization, with an average rate of transformation of 43%. This is attributed to the fact that these areas are more exposed to carcinogens in salivary secretions and that the epithelium is more permeable in this area, as indicated by experimental studies of oral mucosa (Van der Waal, 2010). Leukoplakia is a clinical term and its use carries no implications with regard to the histological findings. However, it is recommended that a histological report should always include a statement on the presence or absence of epithelial dysplasia and if present, the assessment of its severity. Epithelial dysplasia, if present, may range from mild to severe. In some instances, carcinoma in situ and even squamous cell carcinoma are encountered histologically (Smoking and the mouth, 2000). Moderate hyperkeratosis and epithelial hyperplasia without dysplasia are the most common histological findings reported for leukoplakia (Van der Waal, 2010). The epithelium is hyperplastic. Also the hyper keratinisation is seen on the superficial aspect.

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Features for leukoplakia classification

BICC Feature Extraction: BICC features characterize the intensity variations between blocks in an image. The intensity changes between blocks of a frame are represented by block intensity comparison code (Kalaiselvi Geetha *et al.,* 2009). To extract the BICC features, each image is divided into blocks of size K x K Images of size 326 x 244 are used for experimental studies. BICC is computed as follows:

1. Divide the frame into 5 x 5 blocks. (Fig. 5.5)
2. Compute the average intensity in each block.

Fig.1. Homogenous Leukoplakia

Fig. 2. Heterogenous Leukoplakia

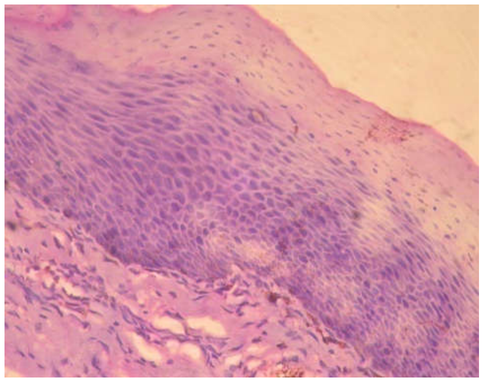

Fig. 3. Microscopic image of Leukoplakia

Fig. 4. Oral Cancer arising from Leukoplakia; OC-Oral Cancer

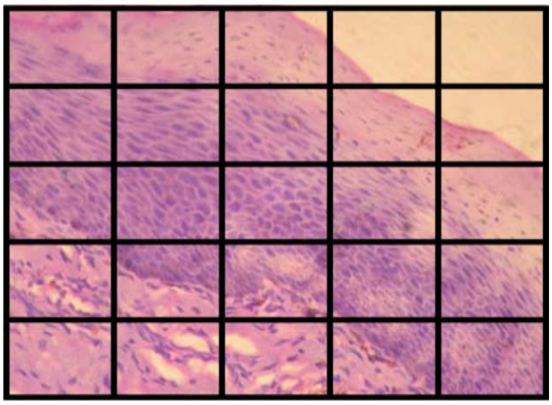

Fig. 5. Leukoplakia image divided into blocks of size 5 X 5

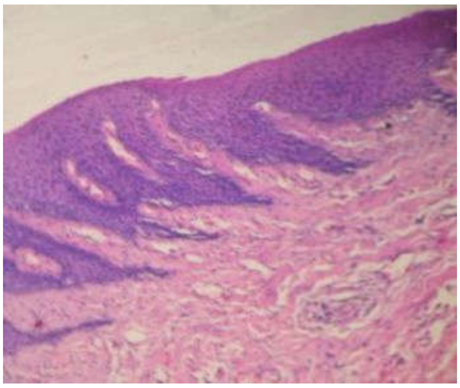

Fig. 6. Normal microscopic image

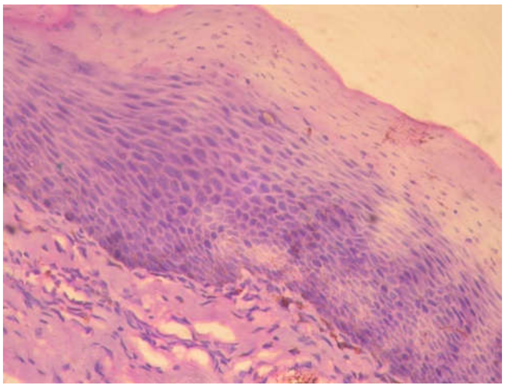

Fig.7. Leukoplakia microscopic image

Table 1. Average performance of normal and Leukoplakia Classification by RBFNN model using BICC features

No. of means	Accuracy(%)					
	Feature vector dimensions (No. of BICC features)					
	10		45		105	
	Normal	Leukoplakia	Normal	Leukoplakia	Normal	Leukoplakia
2	88.0	89.0	87.0	89.2	88.7	90.4
4	86.0	89.5	88.6	90.5	89.0	91.6
6	90.0	91.0	89.4	92.0	94.5	96.0
8	89.0	90.3	89.1	91.9	92.4	94.5

3. Compare the average intensity values of each block in an image with every block in the image.
4. BICC is generated using the formula:

$$Y\left[(i-1)\,25 + j - \frac{i(i+1)}{2}\right] = \begin{cases} 1 \text{ if } x(i) > x(j) \\ 0 \; otherwise, \end{cases} \qquad (1)$$

where $1 \le i \le 25$, $2 \le j \le 24$, $i < j$ and $x(i) > x(j)$ are the average intensities for the i^{th} and j^{th} blocks respectively.

EXPERIMENTAL RESULTS

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

Leukoplakia) + 50 images (25 Normal + 25 Leukoplakia) + 50 images (25 Normal + 25 Leukoplakia)] are used. For testing, 50 microscopic images (25 Normal and 25 Leukoplakia) are used.

Evaluation using RBFNN: For RBFNN training, BICC features are extracted from the images for each category. These features are given as input to the RBFNN model. In Radial Basis Function Neural Network, the weights in the network are determined using the least squares algorithms. For training BICC features for blocks of size 5 x 5, 10 x 10 and 15 x 15, resulting in 16, 45 and 105 dimensional feature vectors respectively which are extracted from the images. These features are given as input to the RBFNN model. The RBF centers are located using k-means algorithm. For each category the value of k is varied from 2 to 8. The system gives optimal performance for k = 6. The weights in the RBFNN network are determined using the least square algorithm. For testing, if the output of the network is greater than the threshold, then it represents a leukoplakia affected image. Table 1 shows the performance of classifying Leukoplakia by RBFNN and the model gives a better performance with k = 6 as shown in Fig. 7. Fig. 8 and 9 show the snapshot of Leukoplakia classification system.

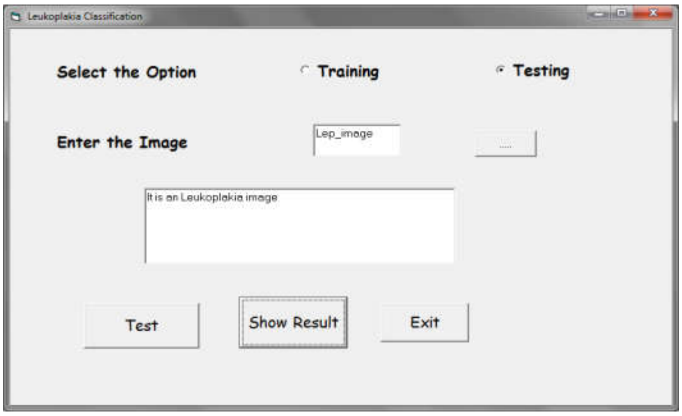

Fig. 9. Snapshot of normal and Leukoplakia classification system (Testing) with BICC features

RBFNN shows the highest accuracy of 96% for leukoplakia classification, for 105 BICC features. OLP classification

RESULTS AND DISCUSSION

Normal and Leukoplakia affected images were collected from Rajah Muthiah Dental College and Hospital. 100 normal and 100 leukoplakia images were used in the experiment. BICC features were extracted from each KxK divided block images. These features were sed as input for the RBFNN model. For each category, k means was varied as 2, 4, 6 and 8. Leukoplakia classification by RBFNN with BICC features gave a maximum performance for k=6 , with an auracy of 96%.

Conclusion

Thus it is clear that RBFNN classification system is a reliable tool for classifying leukoplakia images with BICC features. Experiments with other pattern classifiers could also be attempted in future in the same manner for leukoplakia and other PMDs with BICC and also histogram features , probably for better resuts.

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