Recognition of Oral Lesions By Artificial Neural Network Technique & Discriminate Analysis

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Abstract:

This research used both of the Discriminate analysis(DA) and the Artificial Neural Network(ANN) for differentiation between malignant and benign oral lesions ,that has been dune on a sample of lesions defined them types by the competencies in this field .

The aim is to compare the actual medical diagnosis of oral lesions with both: output of the DA and ANN.

In the DA part, each of discriminate function ,cut point ,rate of error have been founded ,in ANN a perceptron artificial neural network has been used as a successful procedure in classifying the cases of infected and non infected patients, b adjusted a threshold value , training rate , the network have been trained and could identify the disease in two case :Benign (01) and Malignant (01).

The research show a coincidence between medical diagnosis and output of discriminate function _which we can depend on to differentiation between cases and output of neural network.

Introduction

Differentiate between groups is one of the common procedures because of its ability to analyze many practical phenomena and there are several methods can be used for this purpose, such as linear and quadratic discriminate functions. Recently, neural networks is used as a tool to distinguish between groups.

The principle ideas that an individual may belong to one of two groups. We begin by considering how an individual can be classified into one of these groups on the base of measurement of one characteristic In this paper the simulation is used to compare neural networks and

classical method for classify observations to group that is belong to, in case of some variables that don't follow the normal distribution. we use the proportion of number of misclassification observations to the all observations as a criterion of comparison.

This paper presents an evaluation and comparison of the performance of three different feature extraction methods for classification of normal and abnormal patterns in mammogram. Three different feature extraction methods used here are intensity histogram, GLCM (Grey Level Co-occurrence Matrix) and intensity based features. A supervised classifier system based on neural network is used. The performance

of the each feature extraction method is evaluated on Digital Database for Screening Mammography (DDSM) breast cancer database. The experimental results suggest that GLCM method outperformed the

1- Oral cancer

Oral cancer is a significant public health problem. It is includes lesions and malignancies of the mouth, tongue, lips, throat, parts of the nose, and larynx. The major non-modifiable risk factors associated with oral cancer are age, race and gender, while the major modifiable risk factors are tobacco smoking, excessive alcohol consumption, unprotected exposure to ultraviolet radiation (i.e.,sunlight), dietary factors, and viral infection. Detection of oral lesions at earlier stages of development is associated with much more favorable oral cancer survivalrates; however, only 35% of oral cancer is detected at the earliest stage[1]

Although 25% of oral cancer patients have no known risk factors. , but there are risk factor for Oral cancer which are:

- Most oral cancer cases (95%) occur in adults 40 years of age and older; the mean age at diagnosis is 60.
- Oral cancer occurs twice as often in males compared to females nationally and in the state of Michigan.
- Tobacco use has been found to result in approximately 75% of oral cancers, including cancer of the mouth, tongue, lips, and throat.
- Alcohol consumption has been identified as primary risk factor for oral cancer. When combined with tobacco use, the risk is greatly increased.
- Dietary factors, particularly low consumption of fruit, and some types of viral infections also have been implicated as risk factors for oral cancer.
- More recent data has shown that about 25% of mouth and 35% of throat cancers are caused by Human Papillomavirus (HPV).

2- Discriminant Analysis (DA)

In general, Discriminant Analysis **(DA)** is a very useful tool, first: for detecting the variables that allow the researcher to discriminate between different groups, and second: for classifying cases into different groups with a better than chance accuracy.

DA techniques are used to classify individuals in to one or more alternative groups on the base of asset of measurements. The groups are known to be distinct ,and each individual belongs to one of them.

In **DA**, we try to find the combination of variables that best predicts the group to which a n individual belongs. The group identification must be known for each individual used in the analysis. The combination of predictor variables is called a classification function, $L=\alpha_1x_1+\alpha_2x_2+.....\alpha_nx_n$,and this function can then be used to classify new cases whose group membership is unknown.

3- Artificial Neural Network (ANN)

An artificial neural is a computational model inspired in the natural neurons. Natural neurons receive signals through synapses located on the dendrites or membrane of the neuron. When the signals received are strong enough (surpass a certain threshold), the neuron is activated and emits a signal though the axon. This signal might be sent to another synapse, and might activate other neurons.

The complexity of real neurons is highly abstracted when modeling artificial neurons. These basically consist of inputs (like synapses), which are multiplied by weights (strength of the respective signals), and then computed by a mathematical function which determines the activation of the neuron. Another function (which may be the identity) computes the output of the artificial neuron (sometimes in dependance of a certain threshold). ANNs combine artificial neurons in order to process information.

3-1 Perceptron learning rule

The perceptron is a single layer neural network whose weights and biases could be trained to produce a correct target vector when presented with the corresponding input vector. The training technique used is called the perceptronlearning rule. Perceptrons are especially suited for simple problems in pattern classification.

Suppose we have a set of learning samples consisting of an input vector x and a desired output d(k). For a classification task, the d(k) is usually +1 or −1. The perceptron-learning rule is very simple and can be stated as follows:

1. Start with random weights for the connections.
2. Select an input vector x from the set of training samples.
3. If output y_k _= d(k) (the perceptron gives an incorrect response), modify all connections w_i according to: $\delta w_i = \eta(d_k - y_k)x_i$; (η = learning rate).
4. Go back to step 2. (Mandic, D. and Chambers, J.)

4- Materials & Methods

We obtain our sample from master thesis submitted by "Ali D.",It is consisted of 37 patients having 40 lesions, they were different in sex, age habits, job,...etc. ,look to Fig (1), fig (2). Each oral lesion was dealt with 1% toludine blue.

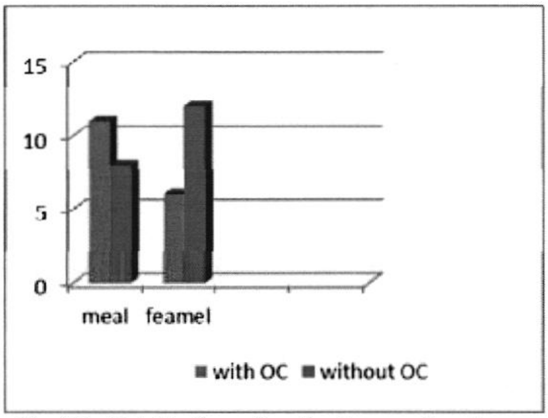

Fig (1): distribution of patient according to sex

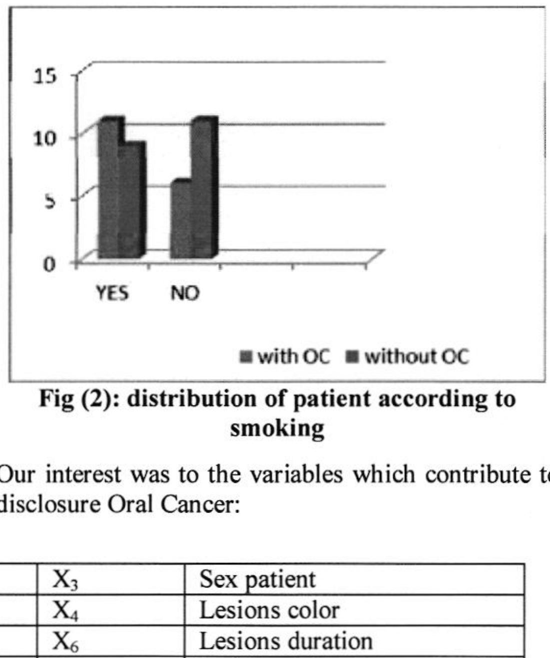

Fig (2): distribution of patient according to smoking

Our interest was to the variables which contribute to disclosure Oral Cancer:

X_1	Age patient	X_3	Sex patient
X_3	Lesions form	X_4	Lesions color
X_5	Lesions location	X_6	Lesions duration
X_7	Interaction with toluidine blue	X_8	Incisional biopsy
X_9	Fine needle aspiration	X_{10}	Exfoliative cytology

The **Clinical Examination**_ as Ali D. show in his theses_ diagnose (/40) were positive by toluidine blue and (/40) were negative.

The **DA model** give us the equation below :

$$L= -0.115\ X_1+1.4991\ X_2+ 0.0036\ X_3 -0.262\ X_4 - 1.15\ X_5 - 10.96\ X_6 +1.346\ X_7 - 7.99X_8 - 22.412\ X_9 +1.347\ X_{10}$$

The cutting point between P^+ and N^-diagnose is: −21.3, implying that when $L \leq -21.3$ the diagnose is N^- and when $L \geq -21.3$ the diagnose is P^+, this was done with true error rate (0.0003), which sign to the power of dicriminat function for recognition between patient with oral cancer and without.

The architecture of the **ANN** used in this study is a single layer architecture with 10 input nodes, and 2 output nodes. The number of input nodes are determined by variables under discuss; and the number of output nodes are represented as a case patient (with oral cancer or without)

Perceptron Learning Rule PLR was used as training technique on 37 patrons , initial weighting determined arbitrary, with threshold value(0.75) and learning rate (0.02), after the error for training iteration stopped decreasing, we achieved a NN that we can independent for recognize oral cancer. Fig (3) show the architecture of NN.

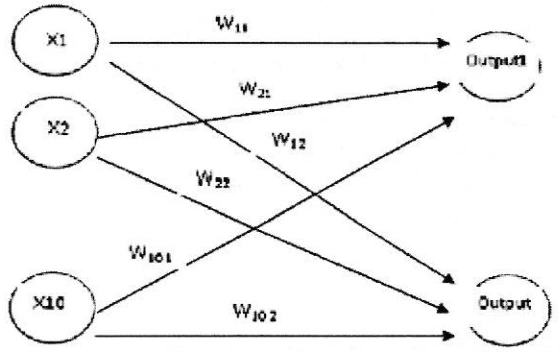

Fig (3): The architecture of NN Oral Cancer recognition

To compare between three methods of recognition CE, DA, ANN we compute Diagnostic Test: Sensitivity ,Specificity, Accuracy as below, Then the value of test shown in Table(1)below the comparative between recognition of three methods depend on Diagnosis Test.

a- Clinical Examination VS Discriminant Analysis

Clinical Examination	Discriminant Analysis				% of True Result	% of False Result
	+ve		-ve			
+ve	a	9	b	8	(a + d)/37%	(b + c)/37%
-ve	c	1	d	19	76	24

b- Clinical Examination VS Artificial Neural Network

Clinical Examination	Artificial Neural Network				% of True Result	% of False Result
	+ve		-ve			
+ve	a	12	b	5	(a + d)/37%	(b + c)/37%
-ve	c	0	d	20	95	5

c- Artificial Neural Network VS Discriminant Analysis

Discriminant Analysis	Artificial Neural Network				% of True Result	% of False Result
	+ve		-ve			
+ve	a	10	b	0	(a + d)/37%	(b + c)/37%
-ve	c	2	d	25	86	14

Table (1) : The comparative between recognition of three methods depend on Diagnosis Test.

Diagnosis Test	Clinical Examination VS Discriminant Analysis	Clinical Examination VS Artificial Neural Network	Discriminant Analysis VS Artificial Neural Network
Sensitivity	90	100	83
Specificity	70.4	80	100
Accuracy	75.7	87	95

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التمييز لأفات الفم عن طريق الشبكات العصبية الاصطناعية و التحليل التمييزي

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الملخص

في هذا البحث يتم استخدام كل من التحليل التمييزي (Discriminate Analysis –DA-) والشبكات العصبية الاصطناعية (Artificial Neural Network –ANN-) للتمييز بين الآفات الفموية الخبيثة النوع والحميدة، اعتمد البحث على عينة تشمل (41) أفة، (12) منها مشخصة طبيا بأنها خبيثة و (29) الأخرى حميدة.

ويهدف البحث الى المقارنة بين دقة نتائج التمييز الحاصلين عليها من كلتا الطريقتين وما تم تمييزه طبيا.

في التحليل التمييزي تم إيجاد: الدالة التمييزية ، نقطة الفصل و نسبة الخطأ، واستخدمت الشبكة العصبية الاصطناعية المدركة Perceptron Artificial Neural Network، وبعد تحديد قيمة نسبة التعليم وتدريب الشبكة تم التوصل الى تصنيف المرض بحالتين (حميد01-Benign أو خبيث 10-Malignant)

وقد اظهر البحث توافق بين التشخيص السريري للحالات المصابة ونتيجة الدالة التمييزية. التي يمكن اعتمادها للتمييز بين الحالات المصابة بالمرض من عدمها اعتمادا على نقطة الفصل، ونتيجة تصنيف الشبكة العصبية بعد تدريبها على التمييز.