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Implementation of Soft Computing for the Betterment of Health Using Traditional Medicinal Methods

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Abstract - **we present a technology to reduce blood pressure using machine intelligence and electro-acupuncture. The pulse of is detected using a sensor mounted on a wrist band. The sensors monitors the pulse of the person and are measured using the genetic algorithm (GA) and fuzzy filter is used for noise reduction. Extracted features are processed to classify the states as "relaxed" and "stress". If the person is found to have high blood pressure Electro-acupuncture is used to overcome it. Electro-acupuncture is similar traditional Chinese method of acupuncture and uses the same acupuncture points, but it does not use needles.**

Keywords: **Soft Computing, Fuzzy Logic, Electro-acupuncture, Blood Pressure**

I. Introduction

Health conditions have been deteriorating in the present due to bad nutrition and stress related issues. The modern technology has always been a key factor for the betterment of the public. The most common and the initial stages of most of the medical illness is the increase in blood pressure. Using machine intelligence to detect the blood pressure and use Electro-acupuncture to reduce the blood pressure.

II. Description

The pulse is monitored by a sensor mounted on a wrist band. The pulse is measured by using soft computing techniques wherein pulse is detected using genetic algorithm and fuzzy filter is designed for noise reduction. Edge detection is based on fuzzy reasoning and linking is done using Hough transform. Extracted features are imported into learning system to classify the affective states between "stress" and "relaxed". The fuzzy SVM is applied to this classification process. The processed information is then subjected to detailed analysis to finalise if the person is having high blood pressure. If found positive the process to reduce blood pressure commences and the data are sent to needed devices. We plan to overcome blood pressure by using traditional Chinese acupuncture but implemented as Electro-acupuncture.

A. Electro-Acupuncture

Acupuncture can overcome various health related problems that we are facing in the present era. Electro-acupuncture is quite similar to traditional acupuncture and the same points are simulated during treatment. The acupuncture points used to treat blood pressure are GV.20, KI.3, KI.7 and ST.36. Buds are used at right acupuncture positions by mounting the buds on bands at specified positions. Buds are then attached to devices that generate continuous electric signals using small clips. These devices are used to adjust frequency and intensity being delivered, depending on condition being treated. Electro-acupuncture uses two buds at time so that the impulses can pass from one bud to other.

III. Significance

One advantage of electro-acupuncture is that a practitioner need not be precise with the insertion of needle. This is because the current delivered through the needle stimulates a larger area than the needle itself. The bands where the buds are placed won't restrict the movement of the person and cause any uncomfortable feeling. It is a method that has high prospects in the near future because of its simplicity and also due to the fact that it doesn't involve any needles.

A. Introduction

Health conditions have been deteriorating in the present due to bad nutrition and stress related issues. The modern technology has always been a key factor for the betterment of the public. The most common and the initial stages of most of the medical illness is the increase in blood pressure. Using machine intelligence to detect the blood pressure and use Electro-acupuncture to reduce the blood pressure. The pulse is monitored by a sensor mounted on the wrist band. The pulse is measured by using soft computing techniques wherein pulse is detected using genetic algorithm and fuzzy filter is designed for noise reduction. Edge detection is based on fuzzy reasoning and linking is done using Hough transform.

The pulse is measured by using a wrist band which are embedded with the proposed technology. Thus by this way we can eliminate the cases which do not point to a rise in blood pressure. This is usually detected by a change in the pulse rate from the studies across various countries

B. Lund Study

A study from Lund, Sweden gives reference values (obtained during bicycle ergometry) for men:
$HR_{max} = 203.7 / (1 + \exp(0.033 \times (age \times 104.3)))$
and for women:
$HR_{max} = 190.2 / (1 + \exp(0.0453 \times (age \times 107.5))$
In such cases the person suffers from immense heart rate and BP and is accompanied by dilation on the pupil size

Fuzzy support vector machine (FSVM) classifiers are a class of nonlinear binary classifiers which extend Vapnik's support vector machine (SVM) formulation. In the absence of additional information, fuzzy membership values are usually selected based on the distribution of training vectors, where a number of assumptions are made about the underlying shape of this distribution On the basis of the idea of structural risk minimization (SRM), Cortes and Vapnik developed the theory of support vector machine (SVM) The main idea behind the SVM algorithm is to separate the samples from different classes with a surface that maximizes the margin between the classes. If the classes are linear separable, the surface is a hyperplane in the input space, otherwise the surface is a hyperplane in the feature space but a hypersurface in input space. Since this approach is an approximate implementation of the structure risk minimization rather than empirical minimization, high generalization can be achieved B.E. Classi×cation with SVM is formulated as quadratic programming (QP) problems which can be solved efficiently by using many well-documented optimization algorithms. When solving Two-Class classi×cation problem using traditional SVM, each training point is treated equally and assigned to one and only one class. However, in many real word problems, there are cases that some training points are corrupted by noise. Moreover, some points in the training data are misplaced on the wrong side by accident. These points are all outliers; thus do not completely belong to one class, but with different memberships in the two classes. In this case, the classical SVM training algorithm will make the decision boundary to severely deviate from the optimal hyperplane because SVM is very sensitive to outliers. To solve this problem, several techniques have been managed, a central SVM method is proposed to use the class centers in building the SVM., an adaptive margin SVM is developed based on the utilization of adaptive margins for each training pattern. the original input space is mapped to a normalized feature space to increase the stability to noise., a robust support vector machine is proposed aiming at solving the over×tting problem. Fuzzy support vector machine (FSVM) is another method to solve this problem. It is developed on the theory of SVM. In FSVM, each sample is given a fuzzy membership which denotes the attitude of the corresponding point toward one class. The membership represents how important is the sample to the decision surface. The bigger the fuzzy membership, the corresponding point is treated more important; thus, different input points can make different contributions to the learning of decision surface. One of the most important thing to FSVM is choosing appropriate fuzzy memberships for a given problem. In this paper, we propose a new fuzzy membership function for the nonlinear support vector machine. We calculate fuzzy membership in the feature space and represent it with kernels. We will show that this method has good performance on reducing the effects of outliers and signi×cantly improves the classi×cation accuracy and generalization. SVM and FSVM can be used to solve Two-Class problem as well as Multi-Class problem. The classi×cation problem mentioned in this paper is concerned to Two-Class Problem; however, the proposed method in this paper can also be applied to Multi-Class problem. This paper is organized as follows: the theory of SVM and FSVM is brie×y reviewed. The details of the new fuzzy membership function for FSVM are discussed some experiment results are carried out to illustrate the advantages of the algorithm. Finally, conclusions are drawn in SVM and fuzzy FSVM In this section we brie×y review the theory of SVM and FSVM in classi×cation problems.SVM Suppose that we have a set of training samples {(X1, y1),(X2, y2)...(XN, yN)}. Each Xi has a class label yi2{1,1}which denotes two classes separately. When the samples are linear separable, the SVM can separate them with a largest margin between the two classes without any wrong separated points. This can be achieved by solving the following quadratic program:

$$\begin{cases} \min & \|\mathbf{w}\|^2 \\ y_i(\mathbf{w}^T X_i + b) \geq 1 & i = 1, 2, \ldots, N. \end{cases} \quad (1)$$

where w is the weight vector and b is the bias term. For a nonlinearly separable case, it is not possible to satisfy all the constrains in (1). Thus, slack variables ni , i 2{1, 2, ...,N} are introduced to measure the amount of violation of the constraints. The QP problem becomes:

$$\begin{cases} \min & \frac{1}{2}\|\mathbf{w}\|^2 + C\sum_{i=1}^{N}\xi_i \\ y_i(\mathbf{w}^T X_i + b) \geq 1 - \xi_i & i = 1, 2, \ldots, N \\ \xi_i \geq 0 & i = 1, 2, \ldots, N. \end{cases} \quad (2)$$

where C is a parameter which has to be determined beforehand to de×ne the cost of constraint violation, a larger C means a higher penalty is assigned to empirical errors. However, in practice, most of the problems cannot be solved by such a linear classi×er; thus, a nonlinear extension is necessary. This can be achieved by mapping the input variable Xi into a higher dimensional feature space, and by working with linear classi×cation in that space. The mapping function U(X) is introduced and it must satisfy Mercer's condition [9, 10]. The vector U(Xi) in the feature space corresponds to vector Xi in the original space. To solve the QP problem, one needs to compute the scalar products of the form U(Xi)*U(Xj) and do not have to know the shape of U(Xi). It is therefore convenient to introduce the kernel function K(Xi, Xj) = U(Xi) AE U(Xj). By using the Lagrange multiplier method and kernel method, one can construct the QP problem as follows

$$\begin{cases} \min & \frac{1}{2}\sum_{i=1}^{N}\sum_{j=1}^{N} y_i y_i \alpha_i \alpha_j K(X_i, X_j) - \sum_{j=1}^{N}\alpha_j \\ \sum_{i=1}^{N} y_i \alpha_i = 0 & \\ 0 \leq \alpha_i \leq C & i = 1, 2, \ldots, N. \end{cases} \quad (3)$$

Some commonly used kernel functions are polynomial, sigmoid and Gaussian function. 2.2 Fuzzy SVM On the basis of the theory of classical SVM, Lin proposed the theory of fuzzy support vector machine in Ref. Chun. In classical SVM, each sample is treated equally; i.e., each input point is fully assigned to one of the two classes. However, in many applications, some input points, such as the outliers, may not be exactly assigned to one of these two classes, and each point does not have the same meaning to the decision surface. To solve this problem, fuzzy membership to each input point of SVM can be introduced, such that different input points can make different contribution to the construction of decision surface Ref. Chun. Suppose the raining samples are

$$S = \{(X_i, y_i, s_i), i = 1, \ldots, N\}. \quad (4)$$

where each Xi belongs to R pwr N is a training sample and yi belongs to{1,+1} represents its class label, si(i=1,2,...,N) is a fuzzy membership which satis×es sigma <= si <= 1 with a sufficiently small constant r>0. Denote a set as Q={Xi| (Xi,yi, si) belongs toS}; clearly, it contains two classes. One class contains such sample point Xi with yi =1, denoting this class by C+, then,The other class contains such sample point Xi with yi =1; denoting this class by C, then It is clearly Q=C+ subsetof C- . The quadratic problem for classi×cation, then, can be described as follows:

$$\begin{cases} \min & \frac{1}{2}\|\mathbf{w}\|^2 + C\sum_{i=1}^{m} s_i\xi_i \\ y_i(\mathbf{w}^T \Phi(X_i) + b) \geq 1 - \xi_i, & i = 1, \ldots, N \\ \xi_i \geq 0, i = 1, \ldots, N & \end{cases} \quad (5)$$

where C is a constant. Since the fuzzy membership si is the attitude of the corresponding point Xi toward one class and the parameter ni is a measure of error in the SVM, the term si ni can be looked as a measure of error with different weights. It is noted that a smaller si can reduce the effect of the parameter ni in problem (5) so that the corresponding point Xi can be treated as less important. Solving problem (5) is as same as that for classical SVM just with a little difference Ref. Chun. Generally speaking, the quadratic programs can be solved by their dual problems [11]. Choosing appropriate fuzzy memberships for a given problem is very important for FSVM. In Ref. Chun, the fuzzy membership function for reducing the effect of outliers is a function of the distance between each data point and its corresponding class center, and the function is represented with parameters of the input space. Given the sequence of training points (4), denote the mean of class C + and class C- as X+ and X- , respectively. The

$$r_+ = \max \|X_+ - X_i\| \quad \text{where} \quad X_i \in C^+, \tag{6}$$

and the radius of class C^- is

$$r_- = \max \|X_- - X_i\| \quad \text{where} \quad X_i \in C^-. \tag{7}$$

The fuzzy membership s_i is [Ref. Chun]

$$s_i = \begin{cases} 1 - \|X_+ - X_i\|/(r_+ + \delta) & \text{if } X_i \in C^+ \\ 1 - \|X_- - X_i\|/(r_- + \delta) & \text{if } X_i \in C^- \end{cases} \tag{8}$$

where d>0 is a constant to avoid the case si =0. The FSVM with the above membership function can achieve good performance since it is an average algorithm. A particular sample in the training set only contributes little to the ×nal result and the effect of outliers can be eliminated by taking average on the samples the same methods can be applied for detecting the dialation in pupil size by using edge detection.

Edge detection is generally seen as an important part of image analysis and computer vision. As a fundamental step in early vision it provides the basis for subsequent high level processing such as object recognition and image segmentation.

The pupil response to cognitive and emotional events occurs on an even smaller scale than the light reflex, with changes generally less than half a millimeter. By recording subjects' eyes with infrared cameras and controlling factors that might affect pupil size, such as ambient brightness, colour and distance, scientists can use pupil movements as a proxy for other processes, like mental strain. Princeton University psychologist Daniel Kahneman showed several decades ago that pupil size increases in proportion to the difficulty of a task at hand. Calculate nine times 13 and your pupils will dilate slightly. Try 29 times 13 and they will widen further and remain dilated until you reach the answer or stop trying, such is the effect that any mental condition has on pupil dilation. Hence it is a very reliable and fool proof method to detect the stress condition on a human.

C. Electro-acupuncture

Electro-acupuncture is quite similar to traditional acupuncture in that the same points are stimulated during treatment. As with traditional acupuncture, buds are inserted on specific points along the body. The buds are then attached to a device that generates continuous electric pulses using small clips. These devices are used to adjust the frequency and intensity of the impulse being delivered, depending on the condition being treated. Electroacupuncture uses two buds at time so that the impulses can pass from one bud to the other. Several pairs of buds can be stimulated simultaneously, usually for no more than 30 minutes at a time.

One advantage of electroacupuncture is that a practitioner does not have to be as precise with the insertion of buds. This is because the current delivered through the buds stimulates a larger area than the buds itself. Another advantage is that electroacupuncture can be employed without using buds. A similar technique called transcutaneous electrical nerve stimulation, or TENS, uses electrodes that are taped to the surface of the skin instead of being inserted. The advantage of this procedure is that it can be used by people who have a fear of buds or a condition that prohibits them from being buds.

On knowing the specific points for treating blood pressure we can pass small volts of electric current to bring the pressure back to a normal. The specific points are GV.20, KI.3, KI.7 and ST.36 .these points are located on the either sides of the spinal cord in between the shoulders and the lower back. Some other points which are suitable for this purpose are on the either sides of the collar bone.

IV. Conclusion

Thus the method we propose is to implement the use of both modern day technology by soft computing (fuzzy filter prevents the consideration of hand movements as pulse) and the traditional medicinal treatment of Chinese acupuncture for the betterment of the general public to improve the standards of living. This method of electro-acupuncture can be used for a wide array of conditions of problems related to eye, sinus, heart, skin, depression, diabetes, back pain etc.

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