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IDENTIFICATION OF ISCHEMIC HEART DISEASE DIAGNOSIS USING POLYNOMIAL SIGMOID SUPPORT VECTOR MACHINE

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ABSTRACT

Medical diagnosis has been considered as an art despite all efforts to standardize, which has been mainly owing to the fact that medical diagnosis requires a proficiency in dealing with uncertainty merely not present in the present day's computing machinery. The researchers have been motivated through the development in computer technology as well as machine learning techniques to enhance software so as to aid doctors in taking resolution without demanding the straight discussion with the experts. In the present manuscript, application of artificial intelligence in usual heart disease diagnosis is being examined. The suggested approaches are pre-processing, bilateral filter as well as DWT for characteristic extraction. These suggested techniques provides an enhanced end result for heart disease recognition with certain phases such as pre-processing phases which suppresses the image quality for the enhancement in affected region. DWT has been a frequently utilized image processing technique that carries out the application of transferring images from the spatial domain into the frequency domain. In the present manuscript, the researchers have introduced a new kernel function known as polynomial sigmoid (PS) which can enhance the classification precision of support vector machines (SVMs). The suggested kernel function merges both Sigmoid (S) and Polynomial (POLY) a kernel as well has been represented in general form. It has been displayed that the suggested kernel meets quicker when compared the Sigmoid and Polynomial kernels. The precision of the suggested algorithm has been compared to algorithms depending on both Sigmoid and Polynomial kernels by application to varied non-separable sets with large number of attributes. The researchers recognized that the suggested kernel provides better classification accuracy in most of the data sets, particularly which are of higher dimensions.

Keywords:Bilateral Filter, Discrete Wavelet Transformation (DWT),Image Dataset, Preprocessing, Sigmoid (S) and Polynomial (POLY) Kernels, Support Vector Machine (SVM).

I.INTRODUCTION

Ischemic heart disease has been much of the common type of cardiovascular disease across the universe. It implies to the issues with regard to the circulation of blood to the muscles in the heart. A fractional obstruction of one or more of the coronary arteries could end in deficiency of sufficient oxygenated blood [1]. A total obstruction of an artery leads to the cause of damaged tissues or a myocardial infarction has been generally

called as heart attack. Ischemia most of the times lead to the cause discomfort or chest pain called as angina pectoris.Realizing the warning signs of heart attack in the very beginning has been considered important for the quick identification and diagnosis. An individual undergoing a heart attack will not even be in a position to understand the crisis going in the body [2]. In the present day times, the number of individuals undergoing heart disease has been on an increasing scale. A lot of people expire each year owing to the heart disease across the universe [3]. Nevertheless, precise diagnosis at the very beginning phase followed by appropriate successive diagnosis could end in a vital lifesaving. Regrettably, precise treatment of heart disease is always a difficult task. In the recent past years, support vector machines (SVMs) are being given substantial consideration due to its extraordinary performance in regression and pattern recognition. Choice of various kernel functions would generate varied SVMs [4] as well might end in varied performances. Certain studies have been executed to limit utilizing the previous knowledge, although the better option of a kernel for a provided issue has been still a research issue which is open. While contrasting SVMs with Gaussian function (GF) to radial basis function (RBF) classifiers could be figured in the review of literature, whereas the spotlight is on a sub-set of techniques as well as only on performance precision [5]. Elucidated a means to ensure an advantage of the approximations inbuilt in kernel classifiers, through the utilization of minimum enclosure of ball algorithm as a means of substitute way to speed up training. Another approach has been suggested in [6] so as to select a fitting kernel to utilize invariance transformations. The disadvantage in this case is that they have been mostly suitable only for a linear SVM classifiers. The techniques could both be applied to the pre-image functions with a separate input space, as they don't need the gradient of the objective function[7].Normally, while implementing the mentioned method, the time duration as well as the space difficulties has been very much higher due to the core of the SVMs being based on estimated minimum enclosing ball algorithms that have been computationally expensive.In the present manuscript, the suggested method has been considerably simple as well as the classification precision has been up to standard, whereas the runtimes have been vitally enhanced when compared with the ascertained Sigmoid and Polynomial kernel (POLY) owing to the larger number of SV for each classifier. Joint Sigmoid and POLY functions in one kernel known as "universal kernel" so as to have a gain of their relevant strength. The universal kernels developed the much ascertained kernels like Sigmoid and Polynomial functions through the optimization of the parameters by utilizing the training data. This kernel convinces Mercer's condition as well as joins quicker when compared to all the present kernels. Entirely accomplishing a SVM with higher precision classification henceforth needs indicating the better quality kernel function. This manuscript tries to address the issue of data classification utilizing SVMs. The researchers have made an attempt to enhance the accuracy of SVMs utilizing a new kernel function. They have made an attempt to concentrate on non-linearly divisible data sets so as to enhance the classification accuracy. The suggested kernel function known as Polynomial Sigmoid Support Vector Machine function (PS-SVM) which joins both Sigmoid and Polynomial kernels, has been evaluated to confirm its advantages over Polynomial and Sigmoid kernels. The SVMs altered through the suggested PS-SVM kernel function has been experimented utilizing various data sets.

II.RELATED WORK

The study displays that the decision support systems have been very much helpful device for physician to sense the heart disease [8]. The neural networks could be efficiently utilized in the decision support system. The key features of neural networks are they possess the capability to understand the complicated nonlinear input-output associations, utilize sequential training processes, as well as they themselves become accustomed to the data. Hence, it has been the option of much of the researchers in decision support systems [9]. The study incorporates the classification of heart diseases utilizing Support Vector Machine(SVM) and Artificial Neural Network(ANN).Comparison has been executed between the two methods taking into consideration the accuracy as well as training duration. This manuscript tries to present a Medical decision support system for heart disease classification in an objective, rational, quicker way and with accuracy. The dataset utilized has been the Cleveland Heart Database obtained from UCI learning data set repository. In the suggested model the researchers try to categorize the data into two classes utilizing the SMO algorithm in SVM and Artificial Neural Network (ANN)[10]. This study makes a comparative attempt to study the generally utilized machine learning algorithms in foreseeing the occurrence of heart diseases. It utilizes the publicly obtainable Cleveland Dataset and models the classification methods upon it. It also brings up the dissimilarities among the various models and assesses their precision in foreseeing a heart disease. The researchers have made an attempt to show that least complex models like logistic regression as well as SVM with linear kernel provide a lot of accurate outputs when compared to their more complicated corresponding part. The researchers have utilized F1 score as well as ROC curves as assessment parameters. Throughout this endeavor, the researchers intend to give a benchmark as well as enhance the previous ones in the area of heart disease diagnostics utilizing the machine learning classification techniques [11]. The ultimate goal of this particular study has been to enhance a proficient heart disease prediction system utilizing feature extraction and SVM classifier which could be utilized to foresee the happening of heart disease. The heart disease forecast system comes to the help of physician as well as professionals in healthcare as a means of tool to diagnose heart disease. To save a patient's life from heart diseases there are quick as well as capable foreseeing technique like PCA with SVM classification technique which is being pursued [12]. this paper suggested dependingon the model to make a comparison with regard to the accuracies of application of rules to the individual outputs of support vector machine, decision trees and logistic regression on the disease [13].This study makes an attempt to present a classifier method to detect heart disease and proves howSVM and Naive Bayes could be utilized for the purpose of classification. In the given system, the researchers will categorize the medical data into five categories such as low, no, high, average and very high. Besides, in case unidentified sample arrives later the system would foresee the class label of that sample. Henceforth, two basic functions such as classification (training) and prediction (testing) would be executed. System's accuracy mostly depends upon the algorithm as well as the database utilized[14].In this manuscript Supervised Learning Algorithm has been taken into consideration for heart disease forecast at the very beginning phase utilizing the patient's medical record and the outputs have been matched up to the known supervised classifier SVM. The data in the record related to the patient is being classified utilizing a Cascaded Neural Network (CNN) classifier. In the classification phase 13 attributes have been provided as input to the CNN classifier to decide the threat of heart disease. The suggested system would give support to the doctors to

treat the disease in a much proficient manner[15]. Medical diagnosis is becoming greatly attributed with the enhancement of technology off late. Additionally the computer and communication tools have enhanced the implementation of medical practice to a better extent. In this manuscript the researchers have made an attempt to project a Decision Support System for the treatment of Heart disease through the radial basis function network structure and SVM. Henceforth, the treatment of Heart disease has been executed through utilization of various data samples from various patients as well as the outputs would mention that SVM with Sequential minimize optimization is equally better as the Radial basis function network in the treatment of Heart disease.The classification accuracy, specificity of the SVM, sensitivity and RBF have been found to be greater finally proving it a better choice for the treatment.

III.PROPOSED WORK

In the proposed system, the overall architecture with description are mentioned below,

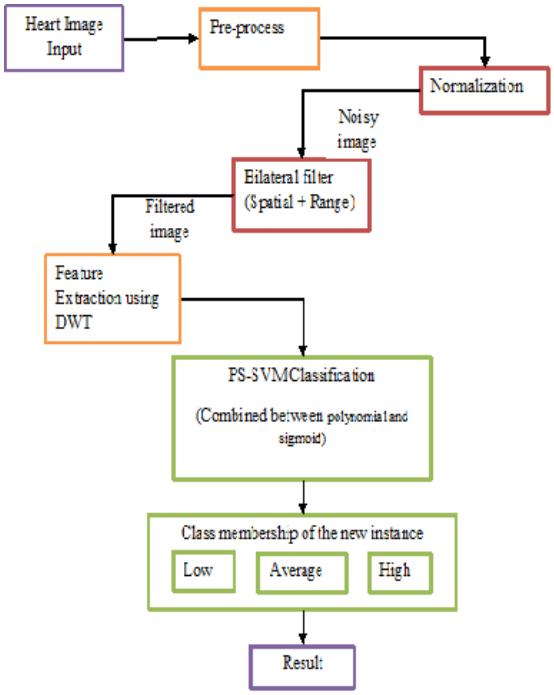

Fig. 1: Overall Architecture

3.1 Pre-Processing

Pre-Processing has been a vital and varied set of image preparation for the subsequent level of image processing depending upon the application. Image pre-processing techniques take a vital role in enhancing the performance and accuracy of post processing application.To work straightaway on obtained images might degrade the end output of built on system; henceforth the researchers begin with improvement as preprocessing technique so as to arrange from less quality images besides to improve the performance of the entire system. Pre-processing engages the concept of normalization and the relevant information is provided below.

1.2 Normalization

Normalization has been one of the essential phases of image pre-processing techniques. Experimental database is being obtained on a confined size grid, Normalization comprises simple techniques such as translation, and scaling and rotation, etc. has been utilized to evade scaling as well as rotational issues. Also in systems at which the writer might have to put his sign on tablets or manuscripts with varied active regions, signature size normalization might be needed.

It has been executed as dataset comprises values at extremes and the greater extreme values don't surpass the lesser extreme values. There have been a range of varied methods present for the process of normalization; they are z-score normalization, min-max normalization and normalization by decimal scaling. From (1) the researchers have utilized z-score normalization which represented by:

$$Z = \frac{X - \mu}{\sigma} s$$

$$X_{norm} = \frac{X - X_{Min}}{X_{Max-} X_{\min}} \quad \text{.....(1)}$$

μ-mean, **σ**-standard deviationat which the mean and standard deviation of every attribute has been determined[23]. To attain the logical outputs, the signatures should be of the same size that is an indication that normalized one.

3.3Bilateral Filter Process

Bilateral filter smoothens the image at the time protecting edges through means of nonlinear amalgamation of neighboring pixel values. It joins gray levels or color oriented on both their geometric proximity as well as their color resemblance. Each pixel in the image has been provided a value which is a weighted mean of the pixels within its neighborhood. Bilateral filter has been the amalgamation of two Gaussian filters: a range one and a spatial one. The spatial Gaussian enacts in a way similar to that of the normal Gaussian filter in allocating greater weights to neighboring pixels as well as smaller weights to remote pixels. The major plan has been to provide a lot of weight to the pixels which are nearer in the spatial, yet in the range domain, to the current central pixel. This gives way to preserve the edges as well as important information, whilst smoothening the regions of slow color distinction. The technique is non iterative, local and comparatively easy, thus accomplishing agreeable outcomes with only a solitary pass. However, answers are being suggested to pace up the evaluation of the bilateral filter.

3.4 Feature extraction scheme using DWT

In the Discrete Wavelet Transform (DWT) coefficients as feature vector. The wavelet has been a strong mathematical too for feature extraction as well as used to extract the wavelet coefficient from MR images. Wavelets have been localized basis functions, which are scaled as well as shifted forms of several unmoved mother wavelets. The prime benefit of wavelets has been that they give localized frequency information with

regard to a function of a signal that has been specifically advantageous for classification. A study of essential fundamental of Wavelet Decomposition has been introduced which are as follows:

$$C(a,b) = \sum_{n \in Z} X[t]\psi_{a,b}[t] \quad \text{..... (2)}$$ Where,

a - dilation or scale, b - translation $\psi_{a,b}[t]$ -discrete wavelet

$$\varphi_{a,b(t)=}(\frac{1}{\sqrt{a}}) \times \varphi(\frac{t-b}{a}) \quad \text{..... (3)}$$ and the wavelet $\psi_{a,b}[t]$ has been computed from the mother wavelet □ through translation as well as dilation,

Wavelet, a dilation factor and b the translation parameter (both are the real positive numbers). Under several placid suppositions, the mother wavelet convinces the limitation of encompassing zero mean. The eq. (1) could be discretized through preventing a and b to a discrete lattice (a = 2^b, a□ R_+; b □ R) to provide the DWT. The DWT has been a linear transformation which functions on a data vector at which its length is an integer power of two, altering it into a numerically unusual vector of the similar length. It is a tool which divides data into diverse frequency components, as well as next studies each component with resolution corresponding to its scale. DWT could be represented as.

$$y_{high}(k) = \sum_n x(t).h(2k-n)$$
$$y_{low}(k) = \sum_n x(t).g(2k-n) \quad \text{..... (4)}$$

The coefficients Y_{high} refer to the detail components in signal x (n) and match to the wavelet function, whereas Y_{low}refer to the approximation components in the signal. The functions h (n) and g (n) in the equation stand for the coefficients of the high-pass and low-pass filters, correspondingly. The key aspect of DWT is representation of function in multi scale. Through the utilization of the wavelets, provided function could be examined at varied stages of solutions.

3.5 PS-SVM Classification Process

Support vector machines (SVMs) are supervised learning algorithms depending upon the theory of statistical learning that may take into consideration as heuristic algorithms. The goal of the SVMs for classification has been to ascertain a hyper plane which divides two classes optimally. An optimum hyper plane has been ascertained utilizing the train data sets as well as its ability to generalize is being cross checked utilizing the test data sets. In the present manuscript, the researchers make an attempt to focus on the binary classification issues. Multiclass classification could be dealt through the conversion of the problem at hand into a lot binary classification ones via classifier fusion methods. Given the labeled binary dataset,

$$(x, x_i) = \{(x, x_i) \mid i = 1.....N, x_i \in (-1,1) \quad \text{..... (5)}$$

Polynomial kernel

$$k(x, x_i) - ((x^t, x_i) + 1)^d \quad \ldots\ldots (6)$$

Sigmoid kernel

$$k(x, x_i) - \tanh((x^{t,} x_i) + b) \quad \ldots\ldots\ldots\ldots\ldots (7)$$

PS-SVM kernel

$$k(x, x_i) - \lim_{-\infty to + \infty} (\sum_{i=0}^{dx} (\varphi) + \sum_{dx}^{dxi} (\varphi)) + b \quad ..(6)$$

The performance of PS-SVM has been generally suboptimal when it is compared to nonlinear ones as they could not handle linearly indivisible data. Henceforth, it has been enviable to expand an SVM model with both the competence of the PS-SVM at the forecast stage and the classification accurateness of the nonlinear SVM classifier.

IV.RESULT AND DISCUSSION

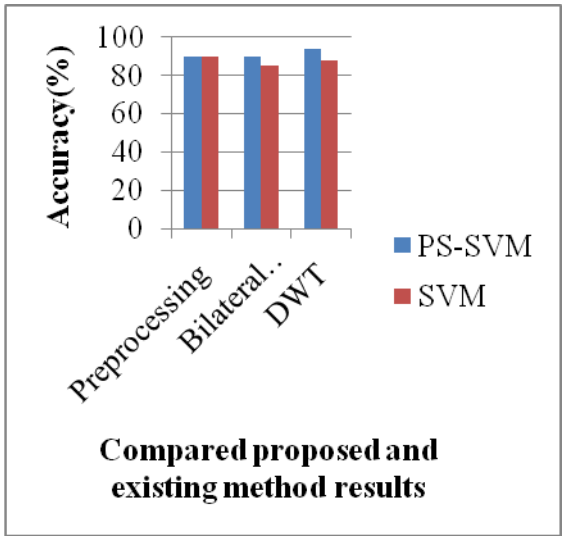

Fig. 2: Compare between existing and propose methods performance results.

Figure 2 displays Accuracy Performances. While comparing to existing techniques the suggested technique PS-SVM classifier possess greater accuracy

TABLE 1: SVM mean accuracy

Kernel	Mean Accuracy
POLY	92.85
SIGMOID	92.52
SP-SVM	96.05

Table 1 displays the mean accuracy the researchers attained from all kernels; it has been clear that the novel suggested kernel attains the most excellent mean accuracy while compared to the classical Gauss and Polynomial function.

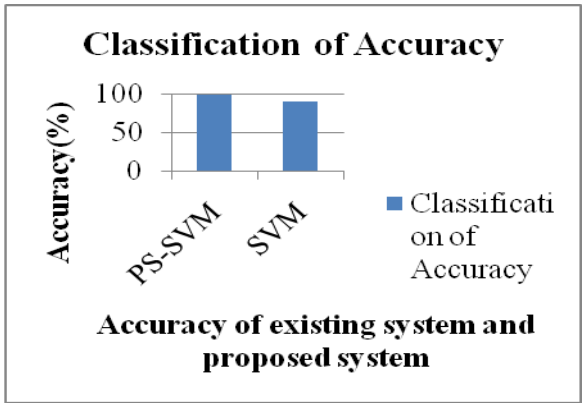

Fig. 3: Accuracy of existing system and proposed system

In the figure 3, the research displays the comparative accuracy in the prevailing system and suggested system. In this fig., the prevailing system accomplishes 90% of accuracy; however in the suggested system the researchers have accomplished 99% of accuracy.

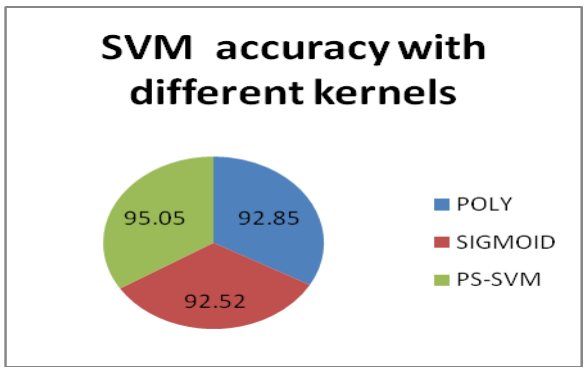

Fig. 4: SVM mean accuracy

Figure 4, Sums up the comparative performance of the SVMs with diverse kernels (POLY, SIGMOID & PS-SVM), it has been obvious that the suggested kernel (PS-SVM) accomplishes the greatest accuracy.

VI.CONCLUSION

In the present manuscript, the researchers have suggested the PS-SVM. This has been a new technique to join linear classifiers for the classification of nonlinear data. This has been completed through the utilization of the combination between Polynomial and Sigmoid on a generative model, which allows the application of priors on the mixing coefficients. A polynomial kernel possesses high-quality capability to boost the recall and a sigmoid kernel has great capability to reduce the error rate. Our PS-SVM method gives a means to competent nonlinear classification through the presenting of a top-down parameter estimation procedure. The method has been quite universal and is chiefly well suitable for large-scale forecast tasks. The researchers have made experiments on synthetic and real-world data and offered comparison to linear and nonlinear SVMs.

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