

# **A Survey on Hybrid Particle Swarm Optimization and Neural Network for Medical Diagnosis**

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**ABSTRACT:** Diabetes Mellitus (DM) is a chronic, lifelong metabolism disorder. It affects the ability of the body system to use the energy found in food. The improper management of the disease will lead to Heart disease, kidney disease, eye disease, nerve disease and pregnancy complications. Classification model helps physicians to improve their prognosis, diagnosis or treatment planning procedures. It is most widely utilized in medical domain to explore patient's data and extract the knowledge from it. This paper aims in developing a novel hybrid classification algorithm for diabetes classification. The Particle Swarm Optimization algorithm is modified and combined with Multi Layer Perceptron Network with back propagation learning and is named as novel Particle Swarm Optimization-Feed Forward Neural Network (PSO-FFNN) Algorithm to classify the diabetic patients as positive as binary 0 and negative as binary 1.

**KEYWORDS:** Diabetic dataset, Particle swarm optimization, Neural Network, Classification

## **I. INTRODUCTION**

Diabetes has been most prevalent disease in the world which is not confined to any specific age group.[1] Threatening all age group make it more worrisome for the doctor and Government all over the globe. We need pensive attention and research to eradicate this menace from the life of people. Deficiency of insulin in human body results in excess glucose (sugar) level because insulin the main agent to regulate the sugar level in our body system.[9] The fundamental reason explored by the medical science for such phenomenon is that the absence of insulin enhances the carbohydrate rich food conversion into glucose which is accumulated in the blood , enhancing the sugar level more than normal. Diabetes is responsible for other diseases like heart disease, kidney damage, blindness, blood vessel damage or it may even cause death. Presently there is no such permanent treatment in medical science for diabetes; however it can be controlled by proper control over diet and regular physical exercise [1].

Detection of diabetes in advance and in early stages is very important for better prevention and cure. The researchers have been founded several techniques to diagnose the diabetes by contributing their continuous efforts and knowledge There have been many techniques used in Neural Networks that were applied over diabetes diagnosis to help physicians. An uncommon approach utilized by Polat and Gunes is Principal element Associate in Nursingalysis and reconciling Neuro Fuzzy reasoning System (ANFIS). In initial stage PCA reduces options for higher accuracy and in second stage ANFIS is employed for classification of polygenic disorder knowledge set [4]. Equally LDA is employed for feature reduction of polygenic disorder knowledge with classification by ANFIS within the second stage [3]. Manjeevan Seera et al have planned 3 methods- Fuzzy Min-Max Neural network (FMM), Classification and Regression Tree (CART) and Random Forest Model (RF) over 3 totally different medical datasets- carcinoma Wisconsin, Pima Indians polygenic disorder and Liver Disorders. Among them FMM-CART-RF generates higher results compared to FMM and FMM-CART results. The conception of fuzzy modeling has been used effectively in diagnosis systems. within the work planned by Sean N. Ghazavi et al 3 strategies namely- fuzzy k-nearest neighbor rule, a fuzzy clustering-based modeling and reconciling Network-based Fuzzy reasoning System (ANFIS) were used

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over Wisconsin carcinoma and Pima Indians polygenic disorder dataset. The classification accuracy obtained is ninety seven.17% and 77.65% severally. many different mechanisms like k-means agglomeration and C4.5 rule are used for polygenic disorder prediction. K-means agglomeration enforced by maori hen tool is used for pattern extraction. The resultant output is given to C4.5 call tree used for classification exploitation k-fold cross validation is employed to separate samples into totally different categories. Preprocessing of knowledge is incredibly vital to enhance the accuracy and to scale the info in same vary of values, that is achieved by Principal element Analysis. The classification of resultant knowledge is completed by Feed forward Higher Order Neural network exploitation k-fold cross validation. Support Vector Machines have proved exceptional success within the space of diagnosis. Within the work planned by V. Anuja kumari et al have classified the polygenic disorder knowledge exploitation SVM classifier with RBF kernel. The classification accuracy obtained is seventy eight.

The classification task consists in distribution instances from a given domain, delineated by a group of distinct price attributes, into a group of categories, which might be thought-about values of selected distinct target attribute known as target conception. The proper category labels area unit typically unknown, however area unit provided for a set of the domain. It is wont to produce the instance from identical domain, describes by identical set of attributes. This follows the overall assumption of inductive learning of the classification task is that the commonest mental representation [2].

The classification Techniques disperse a category to assortment of knowledge records having specific attributes and its values, therefore the classification techniques in aid is applied for nosology functions. A classification model receives a group of connected attribute values, like clinical measurements and offers a category of knowledge records as output.

In our study we tend to propose a brand new technique by adding Particle swarm improvement with Multi layer Neural Network (PSO) to classify designation of Pima Indians polygenic disorder dataset taken from UCI machine learning repository named as Particle swarm improvement Neural Network (PSO). the basic plan for this rule is that at the start stage of finding out the optimum parameter of PSO by meted out random tuples from the input dataset, then PSO is used to accelerate the coaching speed. once the fitness operate price has not amendment for a few generations, the looking method is switched to gradient downhill looking per heuristic information. Finally PSO combined with Neural Network is employed to classify the samples that be 2 classes either '0' for negative (Not Diabetic) or '1' for positive (Diabetic).

## II. LITERATURE REVIEW

In [1], Artificial Intelligence techniques are with success enforced over medical unwellness identification. during this paper we have a tendency to propose Linear Discriminant Analysis and Support Vector Machine for the identification of Pima Indians polygenic disease dataset, wherever LDA reduces feature variables and SVM classifies the info with bigger accuracy. we have a tendency to additionally enforced Feed forward neural network technique for Classification. The experimental results obtained shows that SVM provides higher performance as compared to Feed Forward NN.

diabetes is metabolic disease that arises attributable to high glucose level in body. hypoglycemic agent isn't enough enough in body of diabetic patients to control the sugar level. more many alternative diseases additionally arise from polygenic disease that is dangerous to health. it's necessary to find such a significant health issue as early as doable. to create polygenic disease identification easier for Physicians, there are many strategies used. to achieve bigger performance we've reduced attributes of polygenic disease dataset mistreatment LDA. Then we've enforced and compared 3 totally different techniques Support Vector Machine, Feed Forward Neural Network and LDA with Feed forward networks. On comparison of those strategies, we have a tendency to conclude that LDA-SVM has proven to be far better than the opposite 2 strategies and is additional economical to be handled attributable to its reduced quality.

According to [2], In the application of microarray information, the way to choose atiny low range of informative genes from thousands of genes which will contribute to the prevalence of cancers is a crucial issue. several researchers use numerous process intelligence strategies to analyzed organic phenomenon information.

Results: to attain economical factor choice from thousands of candidate genes that may contribute in characteristic cancers, this study aims at developing a unique methodology utilizing particle swarm improvement combined with a call tree because the classifier. This study additionally compares the performance of our projected methodology with alternative well-known benchmark classification strategies (support vector machine, self-organizing map, back

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propagation neural network, C4.5 call tree, Naive mathematician, CART call tree, and artificial immune recognition system) and conducts experiments on eleven organic phenomenon cancer datasets.

Conclusion: supported applied math analysis, our projected methodology outperforms alternative widespread classifiers for all check datasets, and is compatible to SVM sure enough specific datasets. Further, the work genes with numerous expression patterns and tissue-specific genes are known. These genes give a high discrimination power on cancer classification.

In [3] used hymenopterous insect Colony based mostly arrangement to extract a group of fuzzy rules for identification of diabetes disease. This arrangement was named as ANTMINER. The Classification Accuracy obtained was eighty four.24%. The results reveal that the FCSANTMINER outperforms many strategies in classification accuracy for diabetes disease identification. [4] applied information gravitation based mostly classification formula and obtained seventy six.56% of classification accuracy. [5] developed a cascade learning system that was supported Generalized Discriminate Analysis (GDA) and Least Support Vector Machine (LSVM) to find the polygenic disease. A classification accuracy of seventy eight.21% was obtained once this (LS-SVM) was applied on Pima Indian diabetic information set. [6] Used Fuzzy Neural Network and obtained a classification accuracy of concerning eighty one.8%. [7] has introduced AN instance tally formula ARTMAP-IC. AN accuracy of eighty one was obtained by this methodology. [8] used hybrid formula which mixes Artificial Neural Network and Fuzzy Neural Network. The accuracy obtained was eighty four.2%. [13] developed AN intelligent machine learning technique for classifying the polygenic disease. Expectation Maximization formula was used for clump, Principal part Analysis was used for noise removal and Support Vector Machine was applied for classification. The projected methodology has improved the prediction accuracy and reduced the computation time. it absolutely was developed to help medical practitioners in health care observe. [14] projected a Hybrid Prediction Model (HPM) for the polygenic disease prediction. The filtrated feature choice methodology is employed to pick out the foremost discriminatory predictors. Then 2 bedded classification approach is applied by combining Support Vector Machine (SVM) and Neural Network to boost the general recognition rate of the model. the general accuracy gained during this model is ninety six.09% [9] used General Regression Neural Network (GRNN) for polygenic disease classification. This projected methodology was additionally tested on Pima Indian polygenic disease (PID). The accuracy obtained was eighty.21%. [10] developed a way for polygenic disease classification mistreatment Genetic Programming. The classification was done through 3 stages specifically Feature choice, Feature generation and testing. K-Nearest Neighbour (KNN) and Support Vector Machine (SVM) was used for evaluating the chosen options. [11] projected AN intelligent system supported little World Feed Forward Artificial Neural Network (SW-FFANN). It foretold with AN accuracy of ninety one.66%. [12] Developed AN intelligent identification system supported Linear Discriminant Analysis – reconciling Neuro Fuzzy logical thinking System (LDA-ANFIS). The classification accuracy was around eighty four.61%.

### III. PROPOSED WORK

The new techniques we have implemented in our research are as under -

In Hybrid PSO-NN algorithm the diabetes dataset is given as input to the Hybrid PSO-Neural Network. It consists of 768 samples and 9 attributes out of which the last attribute is 'class' that indicates rather positive or negative. In this rule looking out is additionally started from initializing a gaggle of random particles. First, all the particles square measure updated, till a replacement generation set of particles square measure generated, so those new particles square measure wont to search the worldwide best position within the answer area. Finally the Neural Network rule is employed to look round the world optimum. during this manner, this hybrid rule is might notice Associate in Nursing optimum a lot of quickly. The procedure for this hybrid PSO-Neural Network is summarizing as follows:

#### Algorithm:

Step 1: during this analysis to diagnose the illness} disease taken dataset as input for classification and Initialize the positions and velocities of a gaggle of particles indiscriminately meted out within the vary of [0,1] alongside different parameters values.

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Step 2: evaluate every initialized particle's fitness worth, and  $P_b$  is ready because the positions of current particles, whereas  $P_g$  is ready because the best position of the initialized particles.

Step 3: If the highest unvaried generations are arrived, visit Step half dozen, visit step four.

Step 4: the most effective particle of the present particles is hold on. The positions and velocities of all the particles are updated, then a gaggle of latest particles are generated, if a brand new particle files on the far side the boundary [ $X_{min}, X_{max}$ ], the new position are going to be set  $X_{min}$  or  $X_{max}$ , if the new rate on the far side the boundary [ $V_{min}, V_{max}$ ], the new rate are going to be set  $V_{min}$  or  $V_{max}$ .

Step 5: evaluate every new particle's fitness worth, and therefore the worst particle is replaced by the hold on best particle. If the  $i$ th particle's new position is healthier than  $P_{ib}$ ,  $P_{ib}$  is ready because the new position of the  $i$ th particle. If the most effective position of all new particles is healthier than  $P_g$ , then  $P_g$  is updated.

Step 6: At the tip, calculate the classification rate by applying best parameter values found through PSO in feed forward neural network.

## IV. CLASSIFICATION METHODOLOGY

In our study [15] we implement and compare the experimental results of two techniques- Particle Swarm Optimization and Feed Forward Neural Network combination is called as Hybrid PSO-Neural Network algorithm for classification of diabetes dataset.

Hybrid PSO NN classifier is trained with 500 data samples, and testing is performed using 268 samples[16]. We obtained training and testing classification accuracy of 76.0417% .

**1. Particle Swarm Optimization:**-The notation is used in Particle swarm optimization are as follows:

$X_{id}$  :Component in dimension  $d$  of the  $i$ th particle of swarm

$V_{id}$  :The particle velocity of particle  $I$  in dimension  $d$

$P_{Bi}$  : the best position achieved so far by particle  $i$

$GB$  : The best global best position

$C_1, C_2$  : Constant weight factors

$W$ : The inertia weight

$r_1, r_2$ : Random factors in  $[0,1]$  interval

$V_{min}$  : The minimum velocity value of particle

$V_{max}$ : The maximum velocity value of particle

$y_i$  : The fitness value of particle  $i$

PSO is a population base stochastic optimization technique inspired by the social behavior of swarm, such as bird flocking or fish schooling, to obtain a promising position to achieve certain objectives. The PSO algorithm works by having a population (called a swarm) of candidate solution (called particles). Each particle in a population has a fitness value computed from a fitness function and each particle has a position, and move based on an updated velocity according to few simple formula. The movements of the particles are guided by their own best known position in the search space as well as the entire swarm's best known position. The particle movements are directed by the position vector and velocity vector of each particle. In the  $n$ -dimensional space, the vector and velocity vector of the  $i$ th particle position are represented as  $X_i = [x_{i1}, x_{i2}, x_{i3}, x_{i4}, \dots, x_{in}]$  and  $V_i = [v_{i1}, v_{i2}, \dots, v_{in}]$  respectively, where  $x_{id}$  is a binary bit,  $i=1, 2, \dots, m$  ( $m$  is the number of particles). The record of the position of the previous best performance of the neighborhood is  $GB_i = [g_{b1}, g_{b2}, \dots, g_{bin}]$ . The particle velocity and position is updated and based on Eqs. (A1) and (A2), respectively.

$$V_{idnew} = w \times v_{idold} + c_1 r_1 (p_{bidold} - x_{idold}) + c_2 r_2 (g_{bdold} - x_{idold}), \quad d=1, 2 \text{ ely } D \quad (A1)$$

$$X_{idnew} = x_{idold} + v_{idnew}, \quad d=1, 2, \dots, \text{ely } N \quad (A2)$$

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Where  $c_1$  and  $c_2$  are the positive constant values between 0 and 4, indicating the cognitive and the social learning factors, respectively. The inertia weight ( $w$  has a value between 0.4 and 0.9 and  $r_1$  and  $r_2$  are uniformly distributed with the numbers between 0 and 1. The values of the velocities are between  $v_{min}$  and  $v_{max}$ ,  $N$  is the size of the swarms.

## 2. Feed Forward Back propagation Neural Network

Neural networks are predictive model that have ability to learn, analyses, organize the data and predict test results accordingly. Among several kinds of neural networks, feed forward neural network is usually employed in medical diagnosis applications and others. These networks are trained by a set of patterns called training set, whose outcome is already known. In our study Feed Forward NN consists of input, hidden and an output layer, and the data operates in forward direction, and the error is back propagated to update the weights at every epoch in order to reduce errors.

As mentioned in the proposed work in fig.1, the following two schemes described in 1 and 2 are implemented through Neural Network, which meet the following criteria.

No. of epochs set=500

No. of hidden layer=15

No. of neurons in hidden layer =5

Activation function= Sigmoidal function

Training algorithm=Feed forward Neural Network

## V. CONCLUSION

Diabetes is metabolic disease that arises due to high blood glucose level in body. Insulin is not sufficient enough in body of diabetic patients to regulate the sugar level. Further several other diseases also arise from diabetes which is hazardous to health. It is necessary to detect such a serious health issue as early as possible Diabetes is cause of various diseases in human body. To make diabetes diagnosis easier for Physicians, there have been several methods employed. The diabetic data set is tested with selected classification algorithm.

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