Research Article
Evaluating the Prediction of Heart Failure towards Health Monitoring using Particle Swarm Optimization

[1]S. Radhimeenakshi and [2]G.M. Nasira
[1]Bharathiar University, Coimbatore,
[2]Department of Computer Science, Chikkanna Government Arts College, Tamilnadu, India

Abstract: Heart failure is one of the real cardio-vascular ailments influencing the center matured and the matured. It happens because of diminished cardiovascular yield. It can be both right-sided and left-sided failure of heart. This research study proposes a bio-inspired computing paradigm called particle swarm optimization shortly termed as PSO towards the prediction of heart failure. The implementation is carried out using java. The metrics such as time complexity and prediction accuracy are taken into account for the performance evaluation of the PSO for the prediction of heart failure. Simulation result outputs show the performance improvement of the proposed method.

Keywords: Cardio-vascular, heart failure, particle swarm optimization

INTRODUCTION

Maladies influencing the heart or veins are exceptionally pervasive among individuals encountering homelessness (Strehlow *et al.*, 2009). Among the cardiovascular ailments most normally seen by essential forethought providers serving homeless people are (hypertension), hyperlipidemia (elevated cholesterol and triglycerides) and heart disappointment (weakened cardiovascular capacity, which regularly comes about because of uncontrolled hypertension and/or hyperlipidemia). Coronary illness is a heading reason for death for more established homeless grown-ups (45-60 years) and is three times more basic among more youthful homeless grown-ups (25-44 years) than in the age-matched general population. The significant reason for cardiovascular malady is tobacco use, physical dormancy and a less than great eating methodology. In excess of 80% of cardiovascular illness passing's occur in low-and middle wage nations what's more happen very nearly similarly in men and women. The coronary illness information is aggregate data of blood pressure, Cholesterol issue, diabetes and an alternate complex infection. The social of one illness to an alternate is extraordinary so order undertaking is exceptionally troublesome. The heart disappointment issue is evaluated by physical enacts of user and secured through echocardiography. So forecast of coronary illness is very critical. Overcome this problem introduce a new technique that is PSO (Particle Swarm Optimization).

PSO Classification calculation is utilized within this framework. In numerous neighbourhood and remote innovative work of Healthcare requisitions, the capacities are just restricted to basic observing of information that incorporates imperative signs or giving analysis of specialists about information put away in the Database. Subsequently, examination routines to figure out muddled relations and new data reflecting different key sign characteristics are required (Lee *et al.*, 2003).

Particle Swarm Optimization (PSO) is a well-known and bionic-algorithm focused around the social conduct connected with flying creature rushing for optimization problems. To keep up the differences of swarms, a couple of investigations of multi-swarm system have been accounted for. Notwithstanding, the opposition among swarms, reservation or decimation of a swarm, has not been viewed as further (Liu *et al.*, 2011). The popularity of the PSO framework in these scientific communities is due to the fact that it on the one hand can be realized and, if necessary, adapted to further needs easily, but on the other hand shows in experiments good performance results with respect to the quality of the obtained solution and the speed needed to obtain it. By adapting its parameters, users may in real-world applications easily and successfully control the swarm's behavior with respect to "exploration" ("searching where no one has searched before") and "exploitation" ("searching around a good position"). Numerous studies presented that patients who were affected by Heart Failure (HF). Extensive studies applied Particle Swarm Optimization (PSO) measures for the prediction of HF, in definite as a predictor of the risk of humanity. Also specific studies utilized such methods to detect HF.

Corresponding Author: S. Radhimeenakshi, Bharathiar University, Coimbatore, Tamilnadu, India

LITERATURE REVIEW

In prior work utilizes a transient Detrended Fluctuation Analysis (DFA) has in the past be accomplished in various populaces of CHF and in addition circumstance myocardial localized necrosis patients and was a definitive self-governing indicator of mortality (Raghavi and Lalitha, 2014). Conventional PSO calculation experiences getting trapped at the early stage. On the other side, RSA acknowledges a more terrible result so it can escape from nearby point, oppose earliness meeting and increment the differing qualities of PSO (Zhang and Wu, 2012). It joins together the investigation capacity of PSO and of RSA. Probes four test capacities all show the achievement rates of RSAPSO are more robust than GA, SA and PSO. Right now, ACAR utilizes a help trust skeleton to uncover visit thing sets and create classification rules. It may find more applicable characteristics of each one class mark by utilizing related measures broadening current structure. Additionally the current calculation could be enhanced as far as effectiveness by utilizing the optimization technique (Amit and Mayank, 2014). Data mining system for coronary illness, the points of interest are information order is focused around administered learning algorithms in result which bring about exactness, time taken to construct the algorithm. Tanagra tool is utilized to classify the information and the information is assessed utilizing 10-fold cross validation and the results are compared (Rajkumar and Reena, 2010).

Three classifiers like Naive Bays, Classification by clustering and Decision Tree are utilized to anticipate the determination of patients with the same exactness as acquired before the decrease of number of characteristics. Additionally, the perceptions display that the Decision Tree information mining procedure beats other two information mining methods in the wake of fusing gimmick subset choice with generally high model development time (Anbarasi *et al*., 2010; Nasira and Radhimeenakshi, 2014a).

An illness Using Genetic Algorithm and Ensemble Support Vector Machine, Support Vector Machine (SVM) is accepted to be more effective than neural system and customary factual based classifiers. An outfit of SVM classifiers use various models to acquire better prescient correctness and are more steady than models comprise of a solitary model (Hang *et al*., 2013). The Home or Hospital in Heart failure (HHH) study is another study that was conducted to evaluate a home tele-monitoring system to supervise heart failure patients outside the hospital setting (Mortara *et al*., 2009; Nasira and Radhimeenakshi, 2014b).

In this study, patients took weekly measurements of their weight, heart rate and blood pressure. According to Desai and Stevenson (2010), an effective home monitoring system must contain the necessary elements that together complete the circle of heart failure management. Some of the important circle elements are the reliable measurement of physiological variables that can help in the early detection of adverse events, efficient transmission of data to make possible a timely response, the direct reception of data by personnel qualified to recommend an effective intervention and patient adherence. Today many existing remote monitoring system for heart failure patients suffer the following two shortcomings. Some are invasive, requiring trained technicians to attach sensors to a patient's body (Desai, 2012) or implanted inside of it (Corventis-AVIVO, 2011). Other systems are reactive in nature (Medtronic, 2012) where patients are contacted only when their symptoms are already exacerbated or they are not feeling well. CART utilizes both numeric and unmitigated characteristics for building the decision tree and has in-manufactured peculiarities that manage missing qualities. CART algorithm is connected to distinguish heart failure which takes more of a chance to transform the result (Priyatharshini and Usha Nandhini, 2013).

PROPOSED METHODOLOGY

Particle Swarm Optimization (PSO) is a well-known bio-motivated meta-heuristic for tackling nonstop optimization issues. While this strategy is broadly utilized, up to now just some incomplete parts of the system have been formally explored. Particularly it is decently contemplated how to let the swarm focalize to a solitary point in the pursuit space, no general hypothetical articulations about this point or on the best position any molecule has discovered have been known. For an extremely general class of goal capacities, it is accommodated the first run through results about the nature of the result found. It is demonstrated that somewhat adjusted PSO very nearly doubtlessly discovers a nearby ideal by exploring the recently characterized capability of the swarm. The potential drops when the swarm approaches the purpose of joining, however builds if the swarm stays near a point that is not a nearby ideal, implying that the swarm charges potential and precedes its development.

The beneath is the PSO model which is utilized as a part of the forecast of heart failure. The model depicts the positions of the particles, the velocities (speed) alongside the worldwide and neighbourhood attractors which is a stochastic methodology. It is significant to realize that the capability of the swarm relies on upon the state of the particles and is a key measure for the development of the particles. A swarm (molecule) that is having high potential is more inclined to achieve the inquiry focuses far from the present worldwide attractor. It is likewise to be realized that when a swarm having potential nearing 0 merging. PSO algorithm is a stochastic, populace based workstation critical thinking algorithm. This algorithm centred around the above thought may be delineated as takes after: specifically, bird flocking optimizes a certain destination capacity. Every executor knows its best esteem in this
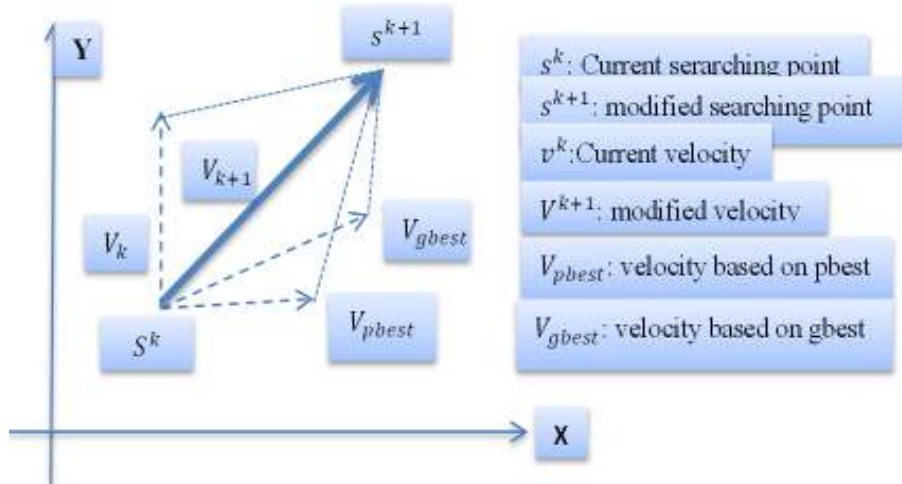
Fig. 1: Modification of a searching point by PSO

way (pbest) and its XY position. Besides, every operator knows the best esteem so far in the gathering (gbest) among pbests. Every operator tries to adjust its position utilizing the accompanying data: (X, Y) is the current position, (VX, VY) is known as current velocities and the distance between the current position and pbest and gbest.

This modification might be spoken to by the idea of velocity. Velocity of every executor might be adjusted by the accompanying equation:

$$v_i^{k+1} = wv_i^k + c_1 rand\ X\left(pbest_i - s_i^k\right) + c_2 rand\ X\left(gbest - s_i^k\right) \tag{1}$$

where,

v_i^k : Velocity of agebt i at emphasis kw: weighting function cj: weighting factorrand: irregular number between 0 and 1

s_i^k : Pbest if agent igbest and current position of agent i at iteration kpbest: gbest of group

Utilizing the above comparison, a certain speed, which steadily draws near to pbest and gbest might be computed. The momentum position (seeking point in the result space) could be changed by the accompanying equation:

$$s_i^{k+1} = s_i^k + v_i^{k+1} \tag{2}$$

Figure 1 shows the finding best values for PSO classification this will be used for feature enhancement. PSO Classification algorithm pseudo code showed as below:

Algorithm for PSO classification:
Input: training date
Iteration number

Generate initial particles
(= Classification rule) randomly
For iteration do numbers do
    For each particle do
        Calculate the fitness value using training data
        Find the pbest
    End for
    Find the gbest
    For each particle do
        Calculate velocity
        Upload particle
    End for
End for
Output: Rule corresponding to gbest

The "best" basically implies the position with the most diminutive target esteem. The Particle Swarm Optimization algorithm calculation is produced by applying the PSO algorithm to the Classification issue. Figure 1 shows the PSO Classification algorithm. The PSO do exclude a solitary global best part of the algorithm and rather utilize various global best that are imparted by independent subpopulations of the particles.

System architecture: An immense measure of information is an enormous measure of information is put away into the Database progressively so that clients could get more faultless dissection results than different requisitions. In any case there are a few detriments, for example, time execution and space created from investigating the gigantic measure of true sensing information. Because of this most existing requisitions give basic restricted analysis to clients after the information is put away and physically examined by the specialists.

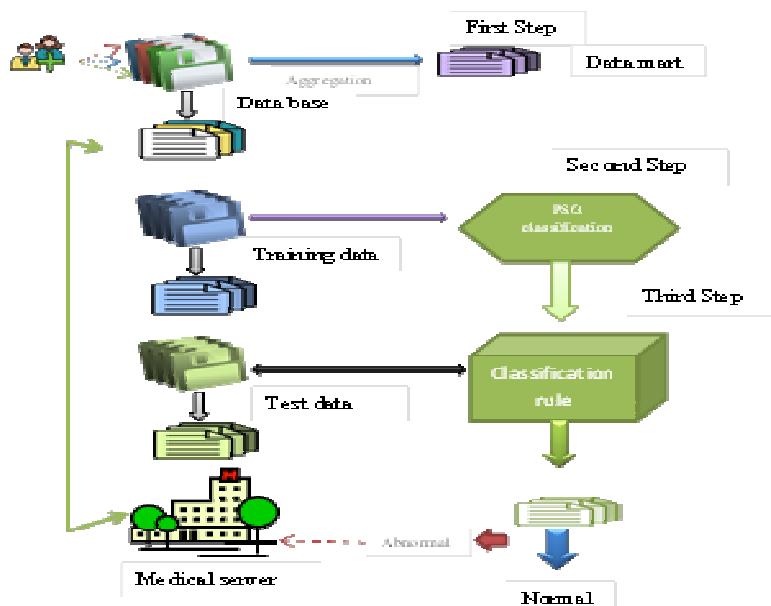To conquer these drawbacks, we propose a framework that to beat these weaknesses; we

Fig. 2: System architecture

recommend a framework that can dissect the blood pressure data naturally. In this framework, blood pressure data is put away into the database progressively and it can order ordinary and irregular cases utilizing the PSO calculation. PSO is a kind of evolution algorithm. It is material to tremendous measures of data and has great time execution and in this way it fits the reason for circulatory blood pressure data analysis. The proposed system architecture diagram shown as Fig. 2.

The proposing system analysis the three basic steps. In the first step patient details are stored into the database in real time and then, to reduce the amount of the Database progressively and after that, to diminish the measure of data, a total methodology is performed. Amassed information is put away into the Datamart and starting arrangement guidelines are haphazardly created.

Data collection: The database is gathered from the dependable web source which indicates European Stat Log extend, that includes looking at the exhibitions of machine taking in, measurable and neural system calculations on information sets from certifiable modern ranges including pharmaceutical, account, picture examination and designing configuration. There are 13 properties likewise called as dimensions. The age which specifies the age of the person, sex denotes the gender, chest pain type has 4 values, resting blood sugar, serum cholesterol level, fasting blood sugar, resting ECG results have three different values, maximum amount of heart rate achieved, exercise induced angina, old peak, slope of the peak exercise ST segment, number of major vessels colored by flourosopy and thal. The above description can be seen in Table 1.

Table 1: Statlog attribute information

S. No.	Risk factor	Description
1	Age	Age in years
2	Sex	Sex (1 = male; 0 = female)
3	CP type	Chest pain type
4	Trestbps	Resting blood pressure (in mm Hg on admission to the hospital)
5	Cholesterol	Serum cholesterol in mg/dL
6	Fasting blood sugar	Fasting blood sugar>120 mg/dL
7	Restecg	Resting electrocardiographic results
8	Thalach	Maximum heart rate achieved
9	Exang	Exercise induced angina
10	Old peak	ST depression induced by exercise relative to rest
11	Slope	The slope of the peak exercise ST segment
12	Ca	Number of major vessels (0-3) colored by fluoroscopy
13	Thal	3 = normal; 6 = fixed defect; 7 = reversible defect

RESULT ANALYSIS

Confusion matrix is a matrix that speaks to the order results. At the point when the disarray matrixes are developed, the specificity, sensitivity and accuracy could be effectively figured as:

$$Specificity = TN/ (TN + FP)$$

$$Sensitivity = TP/ (TP + FN)$$

$$Accuracy = (TP + TN) / (TP + FP + TN + fn)$$

Accuracy: It alludes to the aggregate number of records that are accurately classified by the classifier.

True Positive rate (%TP): It relates to the amount of positive samples that have been rightly anticipated by the classification model.

Table 2: Average time usage of RT and PSO

Data set	Regression tree	PSO
Statlog (heart)	3500.0	1781.0

Table 3: Comparison of RT and PSO (classification accuracy)

Data set	Regression tree	PSO
Statlog (heart)	95.25%	96.35%

Table 4: Comparison of RT and PSO (classification)

Algorithm	TP	FP	TN	FN
Regression tree	141	6	120	5
PSO	143	4	121	4

Table 5: Comparison of RT and PSO (accuracy (%))

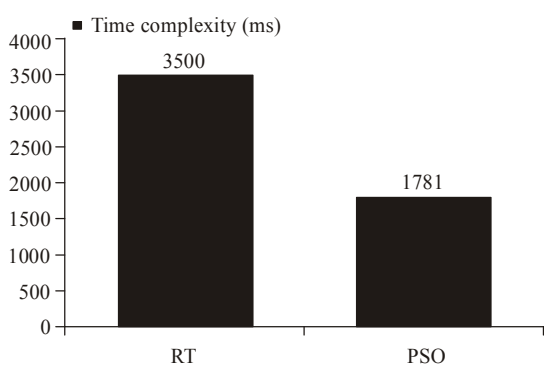| Algorithm	Specificity (%)	Sensitivity (%)	Accuracy (%)	Precision (%)
Regression tree	96.57	95.23	95.25	95.91
PSO	97.27	96.80	96.35	97.20

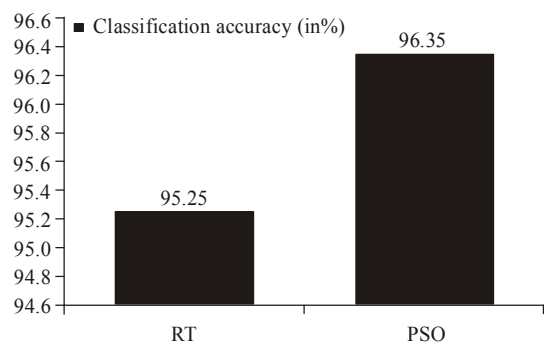Fig. 3: Comparison of RT and PSO (time)

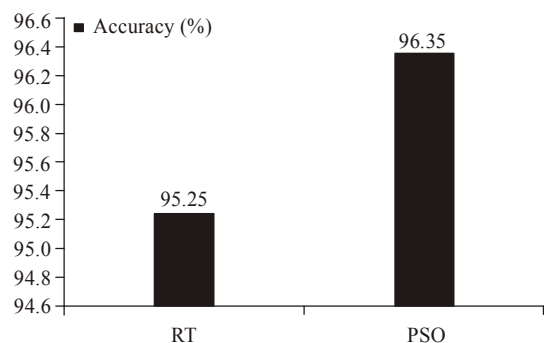Fig. 4: Comparison of RT and PSO (classification accuracy)

Fig. 5: Comparison of RT and PSO (accuracy (%))

False Positive rate (%FP): It relates to the amount of negative samples that have been wrongly anticipated by the classification model.

True Negative rate (%TN): It compares to the amount of negative samples that have been effectively by the classification model.

False Negative rate (%FN): It relates to the amount of positive cases that have been anticipated as negative by the classification model.

True Positive (TP): An occurrence is diagnosed as a patient with Cardio-Vascular Diseases (CVD) that is diagnosed as patient by the master clinicians.

True Negative (TN): An occurrence is diagnosed as typical that is marked as sound by the master clinicians.

False Negative (FN): An example is diagnosed as ordinary with Cardio-Vascular Diseases (CVD) diagnosed by the master clinicians.

False Positive (FP): An occasion is diagnosed as a patient that is marked as a sound individual by the master clinicians. The 10-Fold cross-approval system was utilized to perform the tests. In this system the information set is isolating into 10 subsets and the grouping strategy being tried is run ten times, each one time with a next subset utilized as the test set and the rest utilized as the preparation set. Finally the ten results are arrived at the midpoint of.

Table 2 and Fig. 3 show the average time complexity of Regression Tree (RT) and Particle Swarm Optimization (PSO). In PSO time complexity is minimum and Table 3 and Fig. 4 shows the classification accuracy of Regression Tree (RT) and Particle Swarm Optimization (PSO). In PSO classification accuracy is very high. Table 4 and 5 shows the different classification accuracy of RT and PSO approaches.

In this proposition, existing technique (RT) is connected to locate heart failure which takes more of a time and more memory to prepare the result. Proposed PSO system takes less time and less memory contrast with RT. In this way PSO is best suitable to recognize heart failure.

PSO algorithm concerning correctness got for the real dataset. Figure 5 shows the accuracy improvement of the many, the viability of PSO optimization algorithm has been contrasted and other such optimization techniques such as RT.

CONCLUSION

Wellbeing observing is to discover heart failure prior of healthcare services administrations. Ailment administration programs, which utilize no developed

data and workstation engineering, are as powerful as telemedicine yet more productive in light of the fact that less expensive. Direct discriminant analysis is a customarily received classification strategy. Not with standing, information without peculiarity choice may be excess or uproarious and may corrupt the classification exactness rate. This study proposes a particle swarm optimization based approach that can hunt down a subset of valuable gimmicks. The implementation is carried out using java in Stat log Heart dataset. The simulation results show that PSO outperformed the regression tree algorithm based on classification accuracy and time complexity.

REFERENCES

Amit, S. and S. Mayank 2014. Heart disease prediction using associative relational classification technique (Acar) with som neural network. Int. J. Mod. Eng. Res. (IJMER), 4(2): 17.

Anbarasi, M., E. Anupriya and N.Ch.S.N. Iyengar, 2010. Enhanced prediction of heart disease with feature subset selection using genetic algorithm. Int. J. Eng. Sci. Technol., 2: 5370-5376.

Corventis-AVIVO, 2011. Retrieved form: http://www.corventis.com/us/avivo.asp, 2011.

Desai, A.S. and L.W. Stevenson, 2010. Connecting the circle from home to heart-failure disease management. England J. Med., 363: 2364-2367.

Desai, A.S., 2012. Home monitoring heart failure care does not improve patient outcomes: looking beyond telephone-based disease management. Circulation, 125: 828-836.

Hang, L.W., H.H. Lin, Y.W. Chiang, H.L. Wang and Y.F. Chen, 2013. Diagnosis of severe obstructive sleep apnea with model designed using genetic algorithm and ensemble support vector machine. Appl. Math. Inform. Sci., 7(1S): 227-237.

Lee, M., L. Tian and O. Myagmar, 2013. Design of a particle swarm optimization-based classification system in a WBAN environment. Int. J. Adv. Comput. Sci. Technol. (IJACST), 2(8): 24-27.

Liu, Y., G. Wang, H. Chen, H. Dong, X. Zhu and S. Wang, 2011. An improved particle swarm optimization for feature selection. J. Bionic Eng., 8(2): 191-200.

Medtronic, 2012. CareLink. Retrieved form: http://www.medtronic.com.

Mortara, A., G.D. Pinna, P. Johnson, R. Maestri, S. Capomolla, M.T. La Rovere, P. Ponikowski, L. Tavazzi and P. Sleight, 2009. Home telemonitoring in heart failure patients: The HHH study (Home or Hospital in Heart Failure). Eur. J. Heart Fail., 11: 312-318.

Nasira, G.M. and S. Radhimeenakshi, 2014a. A study on prediction of cardiovascular victimization data processing techniques. Int. J. Comput. Organ. Trends, 9(1): 32-35.

Nasira, G.M. and S. Radhimeenakshi, 2014b. Heart failure prediction using particle swarm optimization in case of remote health monitoring. Int. J. Adv. Res. Comput. Sci. Software Eng., 4(6): 2277-128X.

Priyatharshini, R. and C. Usha Nandhini, 2013. Evaluating the clinical domain with data mining using classification and regression tree (cart) and Particle swarm optimization (Pso) method. Int. J. Innov. Res. Dev., 2(3).

Raghavi, S.I. and P. Lalitha, 2014. Risk assessment analysis of patients suffering from CHF using improved boosting classification tree. Int. J. Adv. Comput. Sci. Technol., 3(3).

Rajkumar, A. and G.S. Reena, 2010. Diagnosis of heart disease using data mining algorithm. Global J. Comput. Sci. Technol., 10: 38-44.

Strehlow, A., D. Robertshaw, A. Louison, M. Lopez, B. Colangelo and K. Silver, 2009. Adapting your Practice: Treatment and Recommendations for Homeless Patients with Hypertension, Hyperlipidemia and Heart Failure. Health Care for the Homeless Clinicians' Network, National Health Care for the Homeless Council, Inc., Nashville, pp: 53.

Zhang, Y. and L. Wu, 2012. A robust hybrid restarted simulated annealing particle swarm optimization technique. Adv. Comput. Sci. Appl., 1(1).