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A Comprehensive Review of Swarm Intelligence Algorithms in the Detection of Heart Disease

Pagalla Bhavani Shankar
M.Tech(CST)
Corresponding Author: Pagalla Bhavani Shankar

Abstract: *This paper presents the comprehensive review of swarm intelligence optimization algorithms in the detection of heart disease. These algorithms are namely, Particle Swarm Optimization (PSO) algorithm and Artificial Bee Colony (ABC) algorithm. By addressing the two swarm optimization algorithms for finding the complex medical diagnosis in the detection of heart disease where human knowledge is apprehended in a general manner. The database used for heart disease detection is Cleveland database obtained from UCI (User Client Identification) Machine Learning Repository. This database contains 76 attributes, but a subset of 14 of them in which 13 are taken as input values and 1 prediction values as an output. Enhancing the results of heart disease detection is based on the best optimistic algorithm of PSO and ABC algorithms*.

Keywords: *Swarm Intelligence, Particle Swarm Optimization (PSO), Artificial Bee Colony (ABC), UCI Machine Learning Repository, Cleveland database.*

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I. Introduction

Heart disease is the leading cause of death in world now days.Heart disease is the leading non-communicable disease. According to world census people is rifely attacked by heart diseases. The count of effecters of heart diseases is increased day by day. 17.3 million Deaths were occurred due to heart disease in every year and it will be 23.6 million approximately at 2030 census.

Tobacco smoking, physical inactivity, alcohol consumption, raised blood pressure (hypertension), raised blood sugar, overweight and obesity, advancing age, inherited (genetic) and unhealthy diets are the major factors contributing for heart diseases. Poverty and low educational status are also risk factors cause the heart diseases & deaths.

This paper is contributing Section 2 describes Literature review, Section 3 explains Swarm Intelligence, Section 4 explains PSO(Particle Swarm Optimization algorithm) algorithm, Section 5 explains the review of ABC (Artificial Bee Colony optimization algorithm) algorithm, Section 6 shows the Problem Definition, Section 7 conveying the Result of review, Section 8 conveying Conclusions and followed by made of references.

II. Literature Review

PSO (Particle Swarm Optimization) algorithm is having wide range of applications and several studies [1, 2, 3] are presented that demonstrate the application of particle swarm optimization algorithm (PSO). It is one of swarm intelligence (section 3) algorithm and it is an ultimate stochastic algorithm.

The review of PSO (Particle Swarm Optimization) algorithm in detail can be found at [1]

S.H.LING at all describes the "New particle swarm optimization algorithm for neural network optimization algorithm".

The working of PSO(Particle Swarm Optimization) algorithm described at [2] "Application of Particle Swarm Optimization algorithm for optimum well location and type" by Jerome E. Onwunalu , Louis J. Durlofsky.

ABC (Artificial Bee Colony) algorithm is also having the several studies and applications [6] is A Novel clustering approach : Artificial Bee Colony algorithm by Dervis karaboga, Celal Ozturk.

And [7] is Heart Disease Detection by enhancing the training phase of neural networks using PSO algorithm (Particle Swarm Optimization algorithm) by Pagalla Bhavani Shankar.

III. Swarm Intelligence

The concept of Swarm Intelligence (SI) is an working environment of Artificial Intelligence (AI), collective behavior of decentralized, self-Organized system that are natural (or) artificial. In, SI systems the populations of any agents are interacting with one to anther with their surface area.

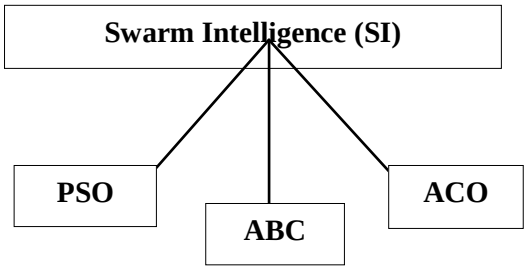

Fig.3.1. Swarm Intelligence Algorithms

Where,
PSO stands Particle Swarm Optimization algorithm, ABC stands Artificial Bee Colony algorithmand ACO stands Ant Colony Optimization algorithm.
Ant colonies, bird flocking, animal hereding, fish schooling and bacterial growth are the examples of natural systems in SI [swarm intelligence].

IV. PSO

In 1995, Particle Swarm Optimization [PSO] algorithm is a population-based swarm intelligence algorithm of bird flocking developed by James Kennedy and Russell C. Eberhart. PSO is an at most superior searching optimization algorithm than all. In PSO, it remembers the best positions as a fitness values simply, remembers the high fitness values.

In PSO, the population of the every element is termed as a "**particle"**. Each particle is associated with best position of fitness value as a"pbest". Another best particle so far by particle of neighbor particles are termed as"lbest".

The concept of PSO gained in popularity due to its simplicity. Like other swarm-based techniques, PSO consists of a number of individuals refining their knowledge of the given search space. The individuals in PSO have a position and a velocity and are termed as a particles. The PSO (Particle Swarm Optimization) algorithm traditionally has no crossover between individuals, has no mutation and particles are never substituted by other individuals during the run. The PSO (Particle Swarm Optimization) algorithm works by attracting the particles to search space positions of high fitness. Each particle has a memory. In PSO (Particle Swarm Optimization) algorithm, the position of the highest fitness value visited by the swarm is called the personal best. Each particle remembers the personal best or pbest , and the position of the highest fitness value that has personally visited, which is called the local best or lbest.

The following flow chart describes the steps involved in PSO (Particle Swarm Optimization) algorithm. The following are the generalized equations for PSO, to obtain the required results.

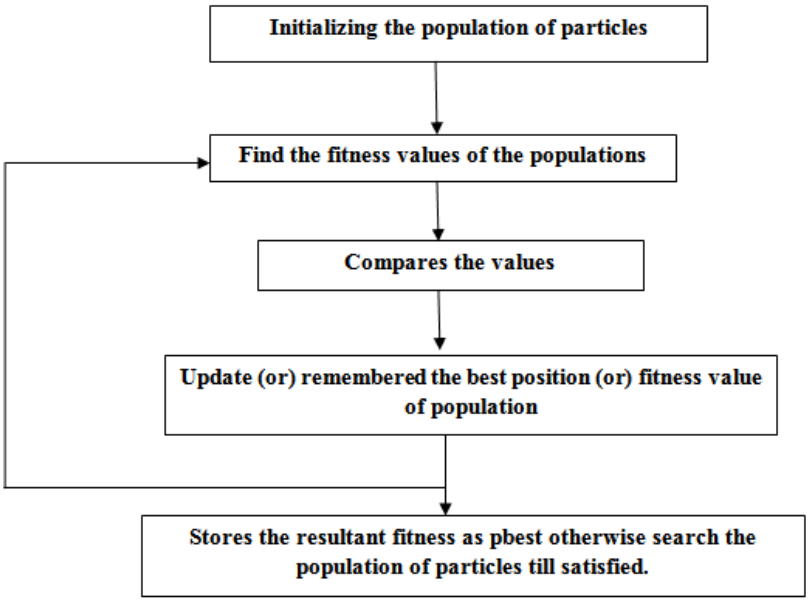

Fig.4.1. Flow chart of the Particle Swarm Optimization (PSO) algorithm

V. ABC

Artificial Bee Colony (ABC) algorithm was proposed by Dr. Karoboga for optimizing the numerical problems. ABC algorithm stimulates the intelligence foraging behavior of honey bee swarms. ABC algorithm is very simple, robust and population based stochastic optimization algorithm. Colony of ABC algorithm is containing three groups of bees.

1. Employed bees – visitors of food source in plane.
2. Onlookers – Making decision to choose a food source.
3. Scouts – Carries random search for discovering the best optimistic food source.

In ABC, the bee colony stimulated by producing a position of food source randomly & replacing it with the abandoned one.

In ABC algorithm, the colony of artificial bees contains three groups of bees: employed bees, onlookers and scouts. A bee waiting on the dance area for making a decision to choose a food source is called onlooker and one going to the food source visited by it before is named employed bee. The other kind of bee is scout bee that carries out random search for discovering new sources. The position of a food source represents a possible solution to the optimization problem and the nectar amount of a food source corresponds to the quality of the associated solution.

Based on the search processes, the employed bee produces a modification on the position in her memory depending on the local information and tests the nectar amount of the new source. Provided that the nectar amount of new one is higher than that of the previous one, the bee memorizes the new position and forgets then old one. Otherwise she keeps the position of the previous one in her memory. An onlooker bee evaluates the nectar information taken from all employed bee and chooses a food source with a probability related to its nectar amount. As in the case of employed bee, she produces a modification on the position in her memory and checks the nectar amount of the candidate source. Providing that its nectar amount is higher than that of the previous one, the bee memorizes the new position and forgets the old one. The food source of which the nectar amount is abandoned by the bees replaced with a new food source by the scouts. In ABC, this is simulated by producing a position randomly and replacing it with the abandoned one.

The following figure 5.1 is a flowchart diagram of ABC (Artificial Bee Colony) optimization algorithm.

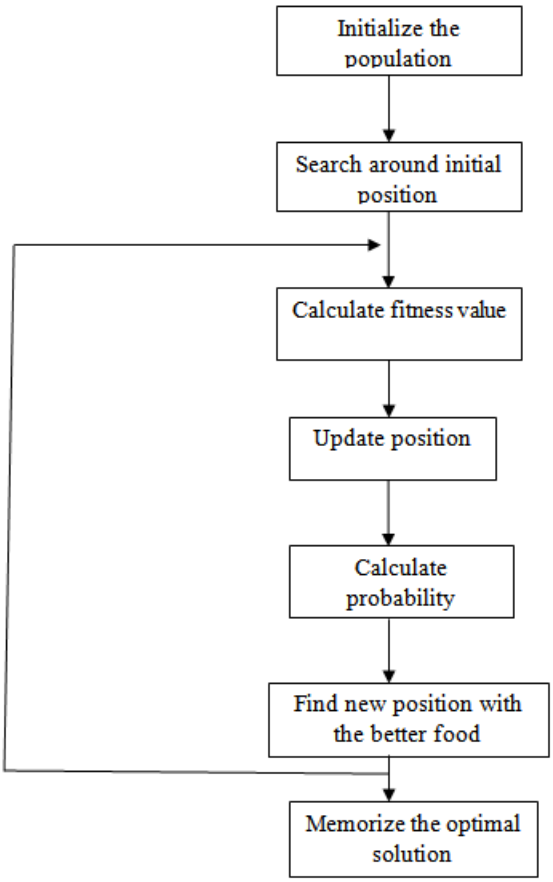

Fig.5.1 Flowchart diagram for Artificial Bee Colony (ABC) Algorithm

VI. Problem Definition

The problem definition of this paper is comes from the following un tackle problems, so that let consider PSO and ABC as an trade mark options for this alternative.

1. Doctors are not having very high accuracy in decision making.
2. They have shortage of expertise.
3. Difficulties in knowledge up gradation.
4. Time dependent performance.

The 6.1. Table shows, which attributes [7] used to be in both **ABC** and **PSO** algorithms.

ATTRIBUTES

No	# No	Attribute	Description	Data Values
1	#3	Age	Age in years	Age values in numbers
2	#4	Sex	Gender	1=male,0=female
3	#9	cp	Chest pain type	Value 1 – typical angina Value 2 – atypical angina Value 3 – non-anginal pain Value 4 – asymptotic
4	#10	trestbps	Resting blood pressure	Blood pressure values
5	#12	chol	Serum cholesterol in mg/dl	Values
6	#16	fbs	Fasting blood sugar>120mg/dl	1=true,0=false
7	#19	restecg	Resting electro cardio graphic results	Value 1 – normal Value 2 – having ST-T wave abnormality Value 3 – showing probable left ventricular hypertrophy by Estel
8	#32	thalach	Maximum heart rate achieved	Values
9	#38	exang	Exercise induced angina	1=yes,0=no
10	#40	Old peak	Old peak	Values
11	#41	Slope	Slope	Value 1 – up sloping Value 1 – flat Value 1 – down sloping
12	#44	Ca	No. of vessels colored by fluoroscopy	No. of vessels
13	#51	thal	thal type of defects	3=normal 6=fixed defect 7=reversible defect
14	#58	num	Predicted number (or) value	Value 0 :<50% diameter narrowing Value 1 : >50% diameter narrowing

Table 6.1.List of attributes

VII. Result and Discussion

By using the generalized indeed concept of ABC (Artificial Bee Colony Optimization algorithm) and PSO (Particle Swarm Optimization algorithm), we calculate the resultant values for the taken attributes. By combining these functionalities, we can provide the best solution to the today's world problem in detection and accuracy of heart disease. ABC is easier when compared to PSO algorithm in the manner of comprehensive analysis. And PSO is little advanced to ABC.

VIII. Conclusion

In this paper, two Swarm Intelligence algorithms are likely to be comprehensively analyzed in the heart disease detection, where the human knowledge is apprehended in general fashion. Both PSO (Particle Swarm Optimization) algorithm and ABC (Artificial Bee Colony) algorithms are likely enhanced in comparative and comprehensive approaches in the detection of heart disease by using Cleveland data base.

Future work is focused on the swarm intelligence [SI] concept, and try to proven and finding the best stochastic algorithms and best optimistic algorithm of Swarm Intelligence remained one algorithms like ACO (Ant colony Optimization) algorithm.

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