Clinical Support System to predict Heart Diseases using ABC Algorithm of Artificial Neural Networks

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Abstract- ABC algorithm is new optimization algorithm based on the intelligent foraging behavior of honey bee swarm Intelligence. ABC algorithm is simple and flexible when compared to the existing swarm based algorithms. We present the ABC algorithm which uses feed forward neural network to predict the heart diseases. The diagnosis of heart disease is a significant and tedious task in medicine. This paper proposes the system which uses Feed Forward neural network to predict the heart attacks. In this the data set with 76 attributes is used provided by UCI machine learning repository to diagnose the heart attacks.

Keywords- Artificial Bee Colony (ABC), neural network, Heart disease, swarm Intelligence, UCI repository.

I. INTRODUCTION

In Real world Applications most Problems have (often Conflicting) objectives that we aim to optimize numerical problems [1]. In order to overcome local optima problem, the researchers from diverse fields are applying hierarchical clustering, partition-based clustering, density-based clustering, and artificial intelligence based clustering methods, such as: statistics, graph theory, expectation- maximization algorithms [6], and artificial neural networks [7], evolutionary algorithms which draw inspiration from evolution by natural selection. Swarm intelligence algorithms [8-10] and so on. In the paper [2] using ABC algorithm with clustering technique they solved local optima problem. Here we are proposed an ABC algorithm with feed forward neural network technique, which is helpful in finding the heart attacks.

Artificial Neural Network (ANN) is currently a 'hot' research area in medicine and it is believed that they will receive extensive application to biomedical systems in the next few years. At the moment, the research is mostly on modeling parts of the human body [4] .There are various advantages of ANN over conventional approaches. Depending on the nature of the application and the strength of the internal data patterns we can generally expect a network to train quite well. Today, neural networks discussions are occurring everywhere. Their promise seems very bright as nature Inspired optimization Algorithms. There are many advantages while using neural networks those are Adaptive learning, Self-Organization, Real Time Operation, Fault Tolerance via Redundant Information Coding [3].

Swarm intelligence has become a research interest to many research scientists of related fields in recent years. Bonabeau has defined the swarm intelligence as “any attempt to design algorithms or distributed problem-solving devices inspired by the collective behavior of social insect colonies and other animal societies” [5].

Swarm intelligence (SI) is the collective behavior of decentralized, self-organized systems, natural or artificial. The concept is employed in work on artificial intelligence. SI systems consist typically of a population of simple agents interacting locally with one another and with their environment. The inspiration often comes from nature, especially biological systems. The agent follows very simple rules, and although there is no centralized control structure dictating how individual agents should behave, local, and to a certain degree random, interactions between such agents leads to the emergence of "intelligent" global behavior, unknown to the individual agents. Swarm intelligence (SI), which was inspired by collective animal behavior, has been developed. The typical swarm intelligence system has the following properties:
(1) It is composed of many individuals.
(2)The individuals are relatively homogeneous.
(3)The interactions among the individuals are based on simple behavioral rules that exploit only local information that the individuals exchange directly or via the environment.

Examples in natural systems of SI include ant colonies, bird flocking, animal herding, bacterial growth, and fish schooling.

II. RELATED WORK AND BACKGROUND

A. Background-

The problems associated with people involve in the diagnosis can considered broadly as:

1. Not having very high accuracy in decision.
2. Shortage of expertise.
3. Difficulties in knowledge up gradation.
4. Time dependent performance.

Because of these problems there is necessity to develop the expert system to provide the assistance mechanism in diagnosis procedure.

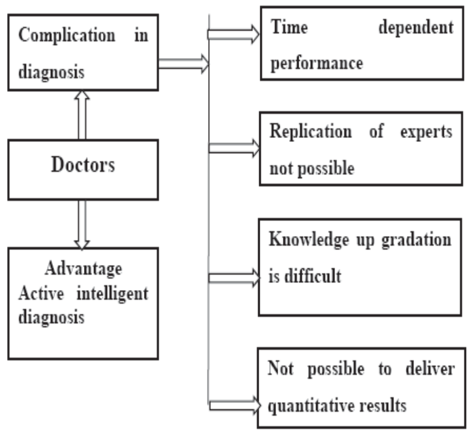


Fig 1: Block diagram of complexity in diagnosis with doctor

B.Related Work

The feed forward neural network was the first and simplest type of artificial neural network devised. In this network, the information moves in only one direction (see Fig 2), forward, from the input nodes, through the hidden nodes (if any) and to the output nodes. There are no cycles or loops in the network. [Ref: wiki]

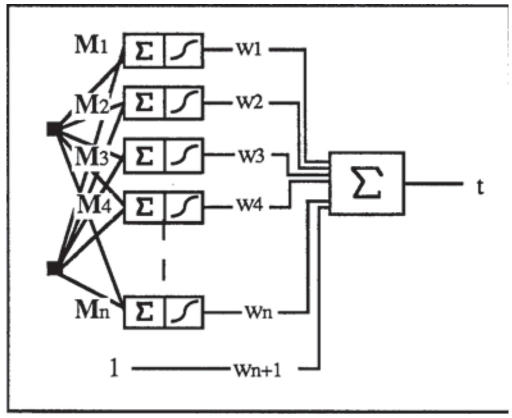


Fig 2: The feed forward network architecture

C.Choice of ABC Algorithm

Our work builds on previous studies focusing on the relationship between the discussions held in PSO algorithm and ACO algorithm. However, instead of using the previous algorithms we use Artificial Bee Colony (ABC) optimization algorithm. The performance of the ABC algorithm is compared with the PSO algorithm and other techniques which are widely used by the researches. The result shows that the Artificial Bee Colony algorithm can successfully be applied to clustering for the purpose of classification. Based on this analysis, we can apply heart disease database on ABC algorithm which is the most efficient algorithm for producing better results when compared to other SI algorithms. There are several issues such as using different algorithms in clustering and comparing the results of ABC algorithm to the result of those algorithms.

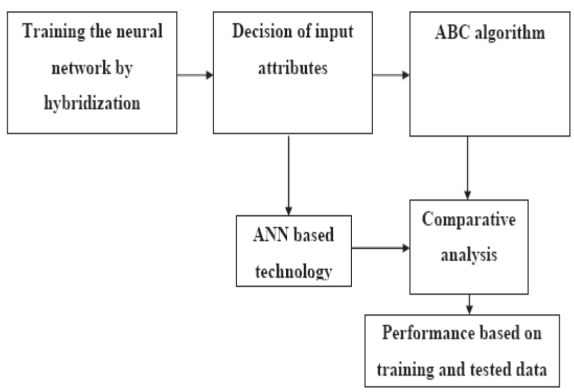


Fig 3(a) Frame work of the proposed algorithm.

Artificial Bee Colony (ABC) algorithm was proposed by Karaboga for optimizing numerical problems. The algorithm simulates the intelligent foraging behavior of honey bee swarms. It is a very simple, robust and population based stochastic optimization algorithm. 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 the 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 is 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.

In order to understand the basic behavior characteristics of foragers better, let us examine Figure 3 (b). Assume that there are two discovered food sources: A and B. At the very beginning, a potential forager will start as unemployed forager. That bee will have no knowledge about the food sources around the nest. There are two possible options for such a bee:

i) It can be a scout and starts searching around the nest spontaneously for a food due to some internal motivation or possible external clue (S on Figure 3 (b).).

ii) It can be a recruit after watching the waggle dances and starts searching for a food source (R on Figure3 (b)).

After locating the food source, the bee utilizes its own capability to memorize the location and then immediately starts exploiting it. Hence, the bee will become an “employed forager”. The foraging bee takes a load of nectar from the source and returns to the hive and unloads the nectar to a food store. After unloading the food, the bee has the following three options:

i) It becomes an uncommitted follower after abandoning the food source (UF).

ii) It dances and then recruits nest mates before returning to the same food source (EF1)

iii) It continues to forage at the food source without recruiting other bees (EF2).

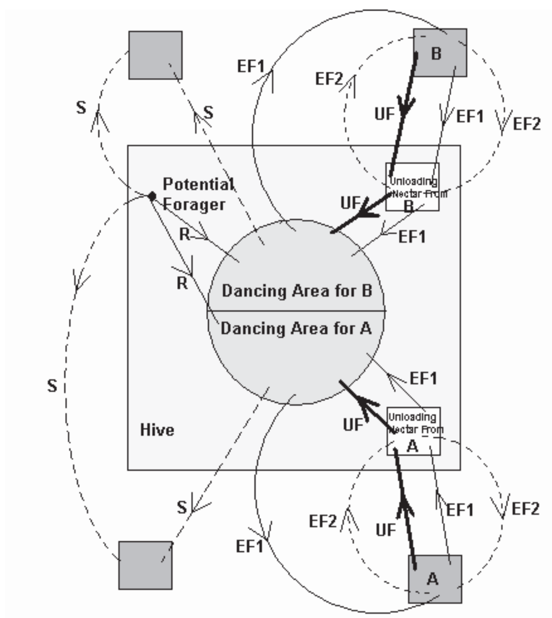


Fig 3 (b) the behavior of honey bee foraging for nectar

PSEUDO - CODE of the Artificial Bee Colony algorithm:

1: Load training samples
2: Generate the initial population *Zi*< i = 1…SN
3: Evaluate the fitness (*fi*) of the population
4: set cycle to 1
5: **repeat**
6: **FOR** each employed bee{
Produce new solution *xi*
Calculate the value *fi*

Apply greedy selection process}
7: Calculate the probability values *pi*for the solutions (*Zi*)
8: **FOR** each onlooker bee{
Select a solution *Zi*depending on *pi*
Produce new solution *xi*
Calculate the value *fi*
Apply greedy selection process}
9: **If** there is an abandoned solution for the scout **then** replace it with a new solution which will be randomly produced
10: Memorize the best solution so far
11: cycle = cycle + 1
12: until cycle = MCN

SN=size of the population
MCN=Maximum Cycle Number

$$x_{ij}(t+1) = x_{ij}(t) + \phi(x_{ij}(t) - x_{kj}(t))$$

$$P_i = \frac{F(\theta_i)}{\sum_{k=1}^{S} F(\theta_k)}$$

$$x_{ij} = x_j^{\min} + r \cdot (x_j^{\max} - x_j^{\min})$$

Experiments

In this work, only Heart Dieseases problems from the UCI database [14] which is a well-known database repository, are used to evaluate the performance of the Artificial Bee Colony algorithm. The data sets and their features: the number of patterns, the number of inputs and one output From the database, the first 75% of data is used in training process as a train set, and the remaining 25% of data is used in testing process as a test set.

Heart database that is a diagnosis of heart disease decides to whether at least one of four major vessels is reduced in diameter by more than 50% or not. This database contains 76 attributes, but here we refer to using a subset of 14 of them in which 13 are taken as input values and 1 prediction value (output).The data is based on Cleveland Heart data from the repository with 303 patterns [2].

Input = 13 Hidden = 100 Output = 1
Dimension = 1501
Input verification 303
Training takes 212 records.....
Number of Inputs = 13
Number of Outs = 1

1.run: 51987.56963335286
2. run:17806.269853875212
3.run:17806.269853875212
4.run:17806.269853875212
5.run:17438.348073118857
6.run:17438.348073118857
7.run:17438.348073118857
8.run:17153.123753748634
9.run:17153.123753748634
10.run:17153.123753748634

Means of 10runs: 20918.0794675581
Training Completed Successfully.........

Testing has been started.....
Input verification 303

Number of Inputs = 13
Number of Outs = 1
Time Taken for 0 iteration in milli seconds: 2325403

Input verification 303
Training takes 212 records.....
Number of Inputs = 13
Number of Outs = 1
1.run:17153.123753748634
2.run:17153.123753748634
3.run:17153.123753748634
4.run:15186.593367968462
5.run:15186.593367968462
6.run:15186.593367968462
7.run:15186.593367968462
8.run:15186.593367968462
9.run:15186.593367968462
10.run:15186.593367968462

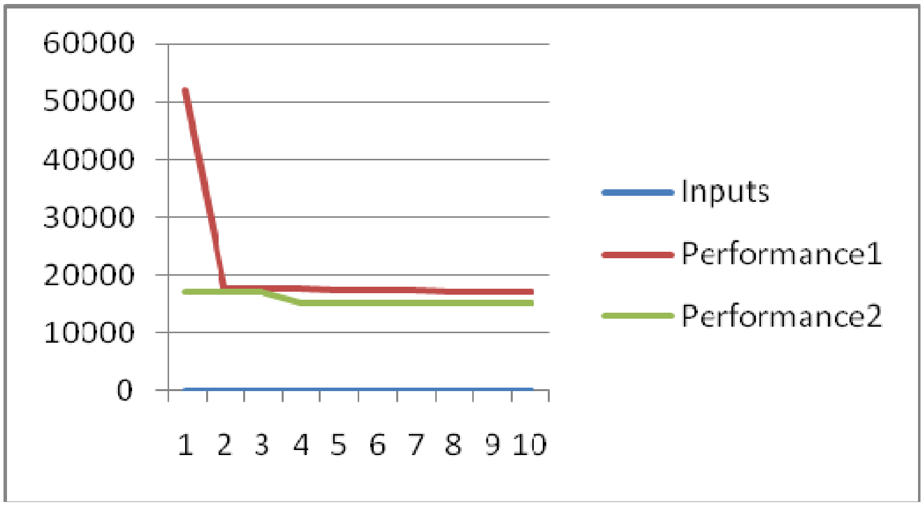
Means of 10runs: 15776.552483702515
Training Completed Successfully.........
Testing has been started.....
Input verification 303
Number of Inputs = 13
Number of Outs = 1

Time Taken for 1 iteration in milli seconds: 2312293
Accuracy: 0.5859375

Table -1 Experiment Result

Inputs	Performance1	Performance2
1	51987.56963	17153.12375
2	17806.26985	17153.12375
3	17806.26985	17153.12375
4	17806.26985	15186.59337
5	17438.34807	15186.59337
6	17438.34807	15186.59337
7	17438.34807	15186.59337
8	17153.12375	15186.59337
9	17153.12375	15186.59337
10	17153.12375	15186.59337

Resulted Graph



III.CONCLUSION

In this paper, we have proposed ABC Algorithm which uses Feed Forword Neural Networks to predict the Heart diseases. We used the data sets of Heart Disease from the UCI Machine Repository and detected the records that are accurate to the conditions that are appropriate to the input attributes and the predicted output. With the predicted out put, the results of the newly designed system is compared and how accurate the data sets with the heart disease can be found. We summarize selected results from predicted values using overall data.

IV FUTURE SCOPE

There are some other aspects of this work that merit further research to improve the accuracy,reliability,efficiency and reduces the computational time.

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