

Heart Disease Prediction Using Bio Inspired Algorithms – Review

N. Sree Sandhya¹, Dr. G N Beena Bethel²

Student¹, CSE Department, GRIET, Hyderabad, Telangana, India
Associate Professor², CSE Department, GRIET, Hyderabad, Telangana, India

E-mail: sreesandhya.n@gmail.com¹, beenabethel@gmail.com²

Abstract

Human heart is an important organ in the human body. It is very helpful for body functioning and removes the waste products from our body by pumping the blood throughout the body. It is very risky to human lives whenever heart disease or failure occurs. To avoid these risks, we predict the early disease symptoms. In medicine and health care domain, with the support of data mining techniques we predict early disease detection, and patient care. Different Algorithms are used for clinical decision support system to get accurate results for effective prediction of heart disease. However, still there's an outsized space for bio inspired algorithms in exploring new areas of application and more opportunities. This review focuses on different bio-inspired algorithms for the heart disease prediction.

Keywords: *Heart disease prediction; Bio Inspired Algorithms, Ant Colony Optimization, Bat Colony Optimization, Artificial Bee Colony Optimization, Genetic algorithm.*

1. Introduction

Optimization is a technique employed to yield cost effective and high performant solution for any given complex problem. Novel algorithms are used for giving solutions of optimized and distributed control problems. But these novel algorithms are derived from the optimization algorithms, which comes from the observations. As the problem size increases, it requires huge amounts of computational efforts for traditional methods. So, to avoid this we use bio inspired algorithms for efficient results in a deterministic approach [1]. The importance of bio inspired algorithms is gradually increased in recent times. The explosion of data becomes more prominent in digital era. It is very difficult to find the solution from standard algorithms due to the complexity of computations.

Worldwide, Mortality rate is highly effected due to the heart disease. It becomes life-threatening disease among all because, heart is the hardest working muscle in our body. It pumps blood, supplying oxygen and nutrients to our body. Due to the heart disease, all these activities done by heart are not properly functioned. So, it is better to identify the risk factors of heart diseases to minimize the deaths. There are many factors like cholesterol, smoking, blood pressure, diabetes, stress, etc., causes heart disease. Regular symptoms of heart disease include discomfort in left side of the chest area, pain in upper abdomen and back, heart burn or indigestion, numbness in legs, etc. These symptoms vary from person to person. So, it becomes thought-provoking to predict the heart disease. To resolve this, intelligent approaches are needed. With a huge increase in data generation, it became extremely challenging to provide a highly efficient and optimal solution. The intelligent approaches like bio inspired algorithms solve these complex problems in time with high efficiency. To solve the traditional optimization problems the current trend uses

bio inspired algorithms because their implementation is based on the biological feature extraction [2].

2. Heart Diseases

Heart Disease Prediction is very important because it leads to human death. Different data mining techniques are implemented on medical data to predict heart disease. Heart disease is one of the expensive health problems to cure [3]. Many people are died in the world due to this heart disease. Human heart has four chambers and the blood flows from one chamber to the other through valves. These valves open and close for the blood to be pumped across one chamber to the other. A situation where the valves are not able to open or close completely, leads to valvular diseases like regurgitation or stenosis. According to the estimates, one in four women or one in five men are prone to the heart ailments, which are varied through one's lifestyle habits, poor diet, obesity, lack of physical activity, diabetes, or excessive intake of alcohol.

Risk factors for heart disease are

1. Smoking: Smokers have high chance of risk than non-smokers.
2. Cholesterol: High Cholesterol leads to heart attacks in most of the cases.
3. Blood pressure: High BP leads to heart attacks because high BP avoids the blood flow to the heart muscle.
4. Diabetes: Diabetic patients are prone to more risk as high glucose levels cause damage to heart nerves and blood vessels
5. Sedentary life style: Sedentary life style leads to many problems like high BP, diabetes, obesity, etc. Then there will be high chance to get heart diseases.
6. Eating Habits: Eating habits plays crucial role because unhealthy eating habits leads to high risk.
7. Stress: Having too much stress leads to high BP then there will be more chances to get heart diseases.

3. Bio Inspired Algorithms

In this survey paper, we restructure Bio Inspired Algorithms for Heart Disease Prediction. Bio inspired algorithms are highly useful for innovations and predictions. Bioinspired algorithms usually mimic the biological processes and are inspired by natural evolution and by the collective behaviour of animals. In this survey, we choose different Bio inspired algorithms like Ant, Bee, Genetic and Bat algorithms used in the heart disease prediction. Through the experiment, this review makes an inference that the performance of Bio inspired algorithms is superior than other approaches [4]. The classification of bio inspired algorithms is below.

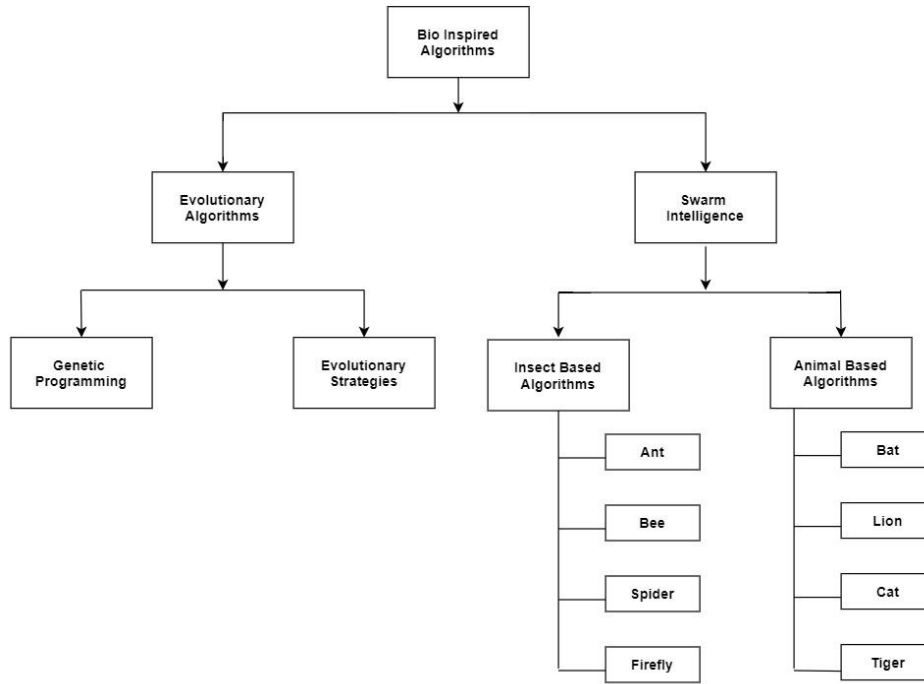


Fig.1 Bio Inspired Algorithms

Binitha S, S Siva Sathya [5], explores on different bio inspired algorithms, grouped by the biological features and implemented in different areas of computing. It was observed that Bio inspired algorithms are most powerful algorithms for optimization and have wide impact on computing.

Rowida Ali AL. Amry; Ghaleb AL-Gaphari [6], in their study explains six different bio inspired algorithms, are cuckoo optimization algorithm, krill herd algorithm, Bat algorithm, grey wolf algorithm, dolphin echolocation algorithm and crow search algorithm. In this thesis, I observed that all these algorithms are based on the intelligent behaviour of animals. This behaviour is more advantage to solve several optimization problems in different domains. A new model FFPSO (Hybrid Firefly and Particle Swarm Optimization) has been proposed by Kora, p [7], for Myocardial Infarction. Raw ECG signals are directly optimized using FFPSO and concluded that it is the best diagnosis for heart disease.

Ant Colony Optimization Algorithm (ACO)

Ant algorithm was proposed by Marco Dorigo in 1992 [8]. This optimized technique is inspired by the actions of real ants' behaviour. This novel approach is employed to solve complex computational and discrete optimization problems. While ants are searching for the food, they leave a white line so that the other ants can take it as a queue to follow for food, called pheromones. Artificial ants simulate the real ants' behaviour in parameter space to yield optimal solutions. ACO is a proven technique for solving travelling salesman problems.

An efficient Ant algorithm has been implemented by Dubey, Animesh, Rajendra Patel, and Khyati Choure [9] with the goal to avoid the risk of heart disease. Max pheromone value gives the risk of heart disease and detection rate was observed in an early stage. For Travelling salesman problems (TSP) solving ACO is extremely used and gives high performance results., A new model for ACO algorithm with multi-direction searching

capacity for improving the performance of Travelling salesman problem has been presented by Zhaoquan Cai [10], included new transition rule with three weight parameters for finding the TSP tour edges.

Artificial Bee Colony Optimization Algorithm (ABC)

Bee Algorithm was proposed by Dervis, Karaboga in 2005. Honey bees traverse in multiple directions in groups to locate food sources [11]. It has been observed that the density of honey bees over heavily pollen flower is higher when compared to less pollen flower. Honey bees are categorized into three types based on their searching of food. Namely, Employed bees, onlookers and scout bees. Once an employed bee finds food sources, it informs to other bees through a dance, is called waggle dance [12]. Onlookers understand the location, quality and quantity of food sources through this waggle dance. Waggle dance comprises of various movements and each one has respective meaning. Based on these signs it will advertise the food location and encourage the remaining bees to follow. After the dance, some recruited members follow the scout bees to find the food source. Scout bees move randomly move from one place to another to discover new flower patches with rich food [13].

Different machine learning algorithms have been implemented in ABC algorithm by Mandeep Kaur, 2Monica Goyal, 3Kamaljeet Kaur [14] for heart disease prediction and diagnoses by entering the details of user symptoms. A novel approach has been described by Chong, C. [15] that uses the foraging model of honey bees to solve the job shop scheduling problem and compared ABC algorithm with ACO and tabu search. ABC Algorithm is also implemented to evaluate the performance of software system by using software reliability growth model developed by Mallikharjuna, R. K., & Kodali, A [16].

Genetic Algorithm

In 1975, John Holland introduced genetic algorithm for solving optimization problems. This evolutionary algorithm [17] produces best solutions for search and optimization problems. Here we use three different biologically inspired operators known as selection, mutation and crossover. Genetic algorithm generates a pool of possible solutions for a given problem. This pool of solutions is called population and Each solution in a pool is known as chromosome. This population of solutions are generated repeatedly until the required fitness value is observed. This mechanism is adopted from Charles Darwin's theory. Genetic algorithm not only deals with discrete and continuous problems but also implemented in multi objective problems.

An efficient algorithm is implemented by B.L. Deekshatulu, M. Akhil Jabbar [18], that combines genetic algorithm with K-Nearest Neighbours for effective classification to predict the heart disease. It provides optimal solution to enhance the accuracy in diagnosis of heart disease. Genetic algorithm is combined with neural networks for heart disease prediction, is given by Latha Parthiban and R. Subramanian [19]. This model uses fuzzy inputs for neural networks to evaluate the complex functions. Genetic algorithm is also combined with particle swarm optimization algorithm to estimate the parameter of SRGM (software Reliability Growth Model). The Genetic Swarm optimization is well worked for achieving the goal of software engineering. This modified genetic swarm optimization is proposed by Mallikharjuna Rao K, Dr. K. Anuradha[20].

Bat Algorithm

Bat algorithm, one of the bio inspired algorithms is a recent one developed by Yang. It is heavily inspired by Bats way of communication using echo-based location [21]. This algorithm can be employed in continuous solution domain to solve both single objective and multiple objective optimization problems. Echo based location is a technique used by bats to find food and navigate even in dark. Bats release a high sound pulse in a definite angle and listen the echo which comes back from the surrounding objects to detect the food, prey and other objects on the way. Bats change intensity of sound and frequency they make when food is found. Similar technique is taken to solve iterative model problems in the field of vector algebra.

For global optimization, a chaotic version of bat algorithm is developed by Gandomi & Yang, Fister et al.,[22]. Here, different chaotic maps are used to validate variants of Chaotic Bat algorithm. The chaotic variants give better results than standard Bat algorithm. Bat algorithm has been used to detect myocardial infarction developed by Padmavati Kora, Kalva Sri Ramakrishna [23]. This is majorly concentrated on ECG signals and the feature extraction is done by using bat algorithm and features are applied to the input of the neural network classifier.

4. Conclusion

Bio Inspired algorithms is a new paradigm that's being adopted in various educational fields. Computer Science, a very important field of education is heavily employing Bio Inspired algorithms to solve many real-world problems. Moreover, these bioinspired algorithms are quite interesting and bridge a gap between computer science, biology, artificial intelligence as well as economics. However, there is so much scope still left for bio inspired algorithms in computer Science as still very minor fraction being explored and there is still lot of room to explore these natural behaviours. This survey paper detailed an overview of bio inspired algorithms like Ant, Bat, Bee and generic algorithms. Here, these bio inspired algorithms analysed for the prediction of heart diseases. In this paper, we have seen different classification methods for predicting heart disease by extracting the features of respective bio inspired algorithms. This study analyses that we can achieve accuracy of heart disease prediction depends on both feature extraction of bio inspired algorithm and type of classification methods used.

References

- [1] Dr. Amit Agarwal, Saloni Jain, March 2014: Efficient Optimal Algorithm of Task Scheduling in Cloud Computing Environment International Journal of Computer Trends and Technology (IJCTT) – volume 9 number 7.
- [2] Kar, A. K. (2016). Bio inspired computing – A review of algorithms and scope of applications. Expert Systems with Applications, 59, 20–32. doi: 10.1016/j.eswa.2016.04.018.
- [3] Ehsan Valian, Shahram Mohanna and Saeed Tavakoli December 2011: Improved Cuckoo Search Algorithm for Global Optimization, IJCIT-2011-Vol.1-No.1.
- [4] Raghunath Satpathy, January 2017: Implementation of Some Bio-Inspired Algorithms in Prediction of Heart Diseases: A Review, IJRECE VOL. 5 ISSUE 3.
- [5] Binitha S, S Siva Sathya, May 2012: A Survey of Bio inspired Optimization Algorithms, International Journal of Soft Computing and Engineering (IJSCE) ISSN: 2231-2307, Volume-2, Issue-2.

- [6] Rowida Ali AL. A mry; Ghaleb AL-Gaphari, December 2018: Survey on Recent Bio-Inspired Optimization Algorithms, IJCSN - International Journal of Computer Science and Network, Volume 7, Issue 6, December 2018 ISSN (Online): 2277-5420.
- [7] Kora, P. (2017). ECG based Myocardial Infarction detection using Hybrid Firefly Algorithm. *Computer Methods and Programs in Biomedicine*, 152, 141-148. doi: 10.1016/j.cmpb.2017.09.015.
- [8] Dorigo, Marco, Vittorio, Maniezzo, Alberto Coloni. "The ant system: An autocatalytic optimizing process." (1991).
- [9] Dubey, Animesh, Rajendra Patel, and Khyati Choure. "An efficient data mining and ant colony optimization technique (DMACO) for heart disease prediction." *International journal of Advanced Technology and Engineering Exploration (IJATEE)*, vol.1, no. 1, pp.1-6, 2014.
- [10] Cai, Z. (2008). Multi-Direction Searching Ant Colony Optimization for Traveling Salesman Problems. 2008 International Conference on Computational Intelligence and Security. doi:10.1109/cis.2008.151.
- [11] Karaboga, Dermis. "Artificial bee colony algorithm." *scholarpedia*, vol.5, no. 3, 6915, 2010.
- [12] Karaboga, Dervis, and Bahriye Basturk. "On the performance of artificial bee colony (ABC) algorithm." *Applied soft computing*, vol. 8, no. 1, pp. 687-697, 2008.
- [13] O. Abdel-Raouf, M. Abdel-Baset, I. El-henawy, February 2014: A New Hybrid Flower Pollination Algorithm for Solving Constrained Global Optimization Problems, *International Journal of Applied Operational Research* Vol. 4, No. 2, pp. 1-13.
- [14] Goyal, M., Kaur, M., and Kaur, K." Heart Expert System using Bee Colony Optimization (BCO) Algorithm and Biogeography Based Optimization (BBO) Algorithm", vol.4, no. (Spl.) 1, pp. 81-83, 2013.
- [15] Chin Soon Chong, Appa Iyer Sivakumar, Malcolm Yoke Hean Low, Kheng Leng Gay, December 2006: A Bee Colony Optimization Algorithm to Job Shop Scheduling , winter simulation conference 06:1954-1961 DOI: 10.1145/1218112.1218469.
- [16] Mallikharjuna, R. K., & Kodali, A. (2015). An Efficient Method for Parameter Estimation of Software Reliability Growth Model Using Artificial Bee Colony Optimization. *Lecture Notes in Computer Science*, 765-776. doi:10.1007/978-3-319-20294-5_65.
- [17] Koza, J.R. (1992)." Genetic Programming: on the programming of Computers by means of natural selection "MIT Press.
- [18] Sankalop Arora, Satvir Singh, May 2013: *International Journal of Computer Applications* (0975 – 8887) Volume 69– No.3.
- [19] Parthiban, Latha, and R. Subramanian. "Intelligent heart disease prediction system using CANFIS and genetic algorithm." *International Journal of Biological, Biomedical and Medical Sciences*, vol.3, no. 3, pp. 157-160, 2008.
- [20] Rao, K. M., & Anuradha, K. (2016). A hybrid method for parameter estimation of software reliability growth model using Modified Genetic Swarm Optimization with the aid of logistic exponential testing effort function. 2016 International Conference on Research Advances in Integrated Navigation Systems (RAINS). doi:10.1109/rains.2016.7764400.
- [21] Mir Jalili, Mir Jalili, & Yang, September 2013: Binary Bat Algorithm, *Neural Computing and Applications* 25(3-4):663-681, DOI: 10.1007/s00521-013-1525-5.
- [22] Amir H Gandomi, Xin-She Yang, January 2013: Chaotic Bat Algorithm in *Journal of Computational Science*.
- [23] Padmavati Kora, Kalva Sri Ramakrishna, November 2015: Improved Bat algorithm for the detection of myocardial infarction in *Springer Plus* 4(1):666, DOI: 10.1186/s40064-015-1379-7.