International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 10 Issue 10, October-2021

Review Paper of Nature-Based Optimization Algorithms for Medicine Predictor

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Abstract— **In comparison to city people, rural residents have less access to healthcare in India. Few competent medical practitioners and healthcare facilities are available in these areas, making them mostly inaccessible to the poor. This problem may be solved by devising a system in which we feed symptoms into an optimization algorithm and return medication names, generic alternative medicines, diagnosis, and a list of nearby hospitals as outputs. This will be extremely beneficial to patients who are experiencing a medical issue. To do so, we identified three algorithms: the Whale Optimization algorithm, the Artificial Bee Colony Optimization algorithm, and the Particle Swarm Optimization algorithm, all of which have high accuracy and could be used with our dataset to provide accurate diagnoses and possible treatments. We also outlined the work's future scope, which includes recognizing crop diseases and anticipating machine maintenance.**

Keywords— Artificial Bee Colony Algorithm, Firefly Algorithm, Nature-based Optimization Algorithms, Particle Swarm Optimization Algorithm, Whale Optimization Algorithm

I. INTRODUCTION

We live in a world where applications aim to maximize performance, efficiency, and sustainability while minimizing costs, energy consumption and environmental impact. The optimization problem that may be written in those circumstances is nonlinear, has a multimodal objective picture, and is subject to a complicated collection of nonlinear constraints, making it difficult to solve. Using basic brute force approaches remains impractical and unpleasant, even as the capabilities of current computers improve. As a result, when it comes to such applications, efficient algorithms are critical. However, for most optimization problems in an application, an efficient algorithm may not exist.

Nature-inspired algorithms are a collection of new problem-solving techniques and approaches that are inspired by natural phenomena. These algorithms are gaining popularity as they are based on simple ideas and are straightforward to execute, essential for finding optimal solutions to multi-dimensional and multi-modal issues, do not need gradient information, can avoid local optima, may be used in a multitude of scenarios spanning many fields and are typically global optimizers, generating search movements in the search space utilizing a group of numerous interacting agents. This type of global optimizer is often simple and adaptable, yet incredibly efficient, as evidenced by case studies and numerous applications. The usage of evolutionary algorithms, which include nature-inspired algorithms like genetic algorithms and swarm intelligence-based algorithms, has been popular in recent years. SI-based algorithms like ant colony optimization, artificial bee colony algorithm, particle swarm optimization algorithm, bat algorithm, firefly algorithm, cuckoo search algorithm, and others have evolved in recent decades. According to a quick assessment by (Fister Jr. et al., 2013), there are over 40 nature-inspired algorithms.

Genetic algorithms were developed by scientist and engineer John Holland and his colleagues at the University of Michigan in the 1960s and 1970s. The main idea behind GAs is to create a group (also known as a generation) of feasible candidate solutions (also known as chromosomes) for a problem at hand, utilizing multiple operators (such as crossover, mutation, and/or inversion) influenced by Charles Darwin's natural selection and evolution theory.

SI-based algorithms replicate the social behaviour of insect colonies. Swarm intelligence is a system property where a coherent functional global pattern arises from the activities of unsophisticated agents interacting locally with their surroundings. These basic agents can interact with one another directly through physical or visual engagement, as well as indirectly by changing their situation. Because they are in a self-organized system, agents perform tasks based on their position or surroundings.

Artificial ants are used in Ant Colony Optimization, a SI-based technique to tackling combinatorial optimization issues. It is based on the behaviour of real ants with improved skills like memory for earlier activities and the ability to calculate distances to other sites. Marco Dorigo revealed his pioneering work on ant colony optimization in 1992 in his Ph.D. thesis on optimization and natural algorithms.

Particle Swarm Optimization is a swarm intelligence approach that uses flocks of birds or schools of fish to make decisions. James Kennedy, an American social psychologist, and Russell C. Eberhart, an engineer, came up with the algorithm in 1995. It makes use of numerous particles to form a swarm. Each particle travels across the search space in pursuit of the global ideal solution.

The Artificial Bee Colony Algorithm is an optimization method based on honeybee swarms' sophisticated foraging behaviour. Derviş Karaboğa created the artificial bee colony in 2005. There are three sorts of bees in the ABC algorithm: employed bees, onlooker bees, and scout bees. The employed bees hunt for food near the food source in their memory, and they transmit this knowledge with the onlooker bees. Onlooker bees tend to pick favourable food sources from those discovered by employed bees. Onlooker bees are more likely to choose the higher-quality food source over the lower-quality one. The scout bees are descendants of a small group of employed bees who abandon their present food sources in search of new ones. In the ABC algorithm, employed bees make up half of the swarm, while onlooker bees make up the other half. The number of solutions is equal to the number of employed or onlooker bees in the swarm.

The Firefly Algorithm (FA) is a metaheuristic algorithm inspired by firefly flashing and bioluminescent communication. It's used to fine-tune machining parameters (feed rate, depth of the cut, and spindle speed). Xin-She Yang created the firefly algorithm in late 2007 and early 2008.

The Cuckoo Search Algorithm (CS) was inspired by some cuckoo species' obligatory brood parasitism, in which they lay their eggs in the nests of other species' host birds, as well as the Levy flying behaviour of some birds and fruit flies. Some host birds may be directly affected by the invading cuckoos. It was suggested in 2009 by Xin-She Yang of Cambridge University and Suash Deb of Raman College of Engineering in India. A new solution is represented as a cuckoo egg, and each egg in a nest represents a solution. The objective is to replace a less-than-ideal solution in the nests with new, maybe better options (cuckoos). In its most basic form, each nest contains one egg.

The Bat Algorithm is used for intelligence optimization inspired by bat echolocation activity. Echolocation is a type of sonar in which bats, specifically microbats, produce a loud and short sound pulse. When they come into contact with an obstruction, the echo returns to their ears after a brief amount of time. Xin-She Yang developed the Bat algorithm for continuous optimization in 2010.

Many industries, including the healthcare industry, employ nature-inspired algorithms. These algorithms may be used to enhance image processing, probabilistic data matching, and medical algorithms, among other things. They can help eliminate some of the uncertainty from medical decision-making and increase the efficiency and accuracy of provider teams, making it easier for healthcare professionals to provide proper care.

Despite their effectiveness and popularity, nature-inspired algorithms, nevertheless, have several drawbacks, particularly from a theoretical viewpoint. Even though academics have a solid grasp of how such algorithms work in practice, it is unknown why and under what conditions they work. Furthermore, all nature-inspired algorithms have algorithm-dependent parameters, the values of which may affect the algorithm's performance. However, the ideal values or settings, as well as how to adjust these parameters for the best outcomes, remain unknown. Furthermore, while some theoretical studies of nature-inspired algorithms exist, a unified mathematical framework is still needed to assess all algorithms to get a comprehensive understanding of their stability, convergence, rates of convergence, and robustness.

II. MOTIVATION

Medical care is an essential requirement for all. However, rural populations have less access to healthcare than city dwellers. In these areas, very few good medical practitioners and healthcare facilities are available which are largely inaccessible to the poor. Due to this problem, timely response in times of crisis is not possible, and thus, alternative ways for access to good medical opinion have emerged, such as medical consultations over the phone or the internet, as well as mobile preventative care and treatment programs. Even if a healthcare practitioner makes a diagnosis, several medications accessible in metropolitan regions are not available in rural locations. People may be unaware of alternative or generic drugs that are inexpensive, effective, and locally available. The above-mentioned difficulty can be mitigated by devising a method in which we provide symptoms as input to an optimization algorithm and receive names of drugs, their generic alternative medicines, diagnoses, and nearby hospitals as outputs. This will be a great help for patients who are in crisis.

III. LITERATURE REVIEW

In (Bagirov & Churilov, 2003), a Nonsmooth Nonconvex Optimization-Based Algorithm has been proposed where the algorithm produces clusters step by step, letting the decision-maker simply adjust the number of clusters based on the criteria supplied by the nature of the decision-making scenario while avoiding the obvious costs of increasing solution complexity. To prevent small, artificial clusters from developing, the suggested approach utilizes a stopping condition.

In (Muthukaruppan & Er, 2012), a Particle swarm optimization (PSO) based fuzzy expert system was developed to diagnose coronary heart disease. The fuzzy system can be formulated as a space search problem, where each point in the space corresponding to a rule set and MFs, which made PSO a better choice for searching these spaces with this method, as the accuracy of 93.27% was obtained.

In (Neshat et al., 2012), the combination of two techniques, PSO and CBR, has been utilized to identify hepatitis illness. A Case-Based Reasoning approach has been used to preprocess the data set, and a weight vector for each feature is retrieved. A Particle Swarm Optimization model is then used for assembling a decision-making system based on the recognized features and diseases. CBR-PSO method could diagnose hepatitis disease with an accuracy of 94.58%.

In (Babaoğlu et al., 2013), a hybrid Artificial Bee Colony and K-Nearest Neighbor Classifier have been proposed to diagnose coronary artery disease. The proposed approach is useful for a two/multi-class classification problem. ABC-kNN has an accuracy of 95.28%.

In (Vieira et al., 2013), a modified Binary Particle Swarm Optimization (MBPSO) method for feature selection with the simultaneous optimization of SVM kernel parameter setting to optimize feature selection has been proposed.

In (Subanya & Rajalaxmi, 2014), an ABC-SVM has been proposed and compared with forwarding Feature Selection. The ABC algorithm optimizes the process of feature selection and yields the best optimal feature subset which increases the

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 10 Issue 10, October-2021

predictive accuracy of the classifier. The experimental results of the ABC-SVM algorithm with the heart disease data showed an accuracy of 86.76%.

In (Sayed et al., 2016), the Whale Optimization Algorithm has been used as a feature selection algorithm where three operators are included to mimic encircling prey, searching for prey, and humpback whales' bubble-net foraging behaviour. The experimental results show overall 98.77 % accuracy, 99.15 % precision, 98.64 % recall, and 98.9 % f-score.

In (Zamani and Nadimi-Shahraki, 2016), Feature Selection based on Whale Optimization Algorithm has been used to remove irrelevant and superfluous characteristics to decrease the amount of data and improve efficiency of learning algorithms. The accuracy of the proposed algorithm observed on these medical datasets for Hepatitis is 87.10%, for Breast Cancer is 97.86%, for Pima Indians Diabetes is 78.57% and for Statlog Disease is 77.05%.

In (Barham & Aljarah, 2017), the Whale Optimization algorithm is used to solve the link prediction problem, which is formulated as an optimization problem to predict the links in any type of network. In this solution, WOA has a G-mean of 0.7356, whereas Genetic Algorithm and Differential Evolution Algorithm have G-means of 0.7344 and 0.6532, respectively.

In (Kaur & Sharma, 2017), a performance comparison has been done between Genetic Algorithm, Ant Colony Optimization, Particle Swarm Optimization, and Artificial Bee Colony to diagnose diabetes, cardiac disorder, and cancer. The conclusion suggested that the rate of accuracies accomplished using GA, ACO, PSO, and ABC in the early diagnosis of cancer, diabetes, and cardiac problems lie between 73.5% to 99.7%, 70% to 99.2%, 80% to 98%, and 76.4% upto 99.98% respectively.

In (Kumar & Khorwal, 2017), a Firefly-SVM has been proposed and compared with Genetic-SVM. The hybrid firefly-SVM model brings an accuracy improvement of 5.64 on average. Classification accuracy increases on an average by 3% in the case of the genetic algorithm and by 5.64% in the case of the firefly algorithm.

In (Kumar & Sahoo, 2017), an Artificial Bee Colony Algorithm for feature selection with coupled K-Nearest Neighbor and Genetic Algorithm for effective classification has been proposed. The proposed system eliminates unnecessary features, as evidenced by classification accuracy of 95.94 %, 80.20 %, and 98.84% for hepatitis, diabetes, and heart datasets, respectively.

In (Sengupta & Das, 2017), an Incremental Particle Swarm Optimization Algorithm has been proposed which can generate classification rules both in a static and dynamic environment. PSO produces an accuracy of 93% on average.

In (Shrivastava et al., 2017), a comparative analysis of various nature-inspired algorithms was done to select optimal features/variables required for aiding in the identification of patients affected with Parkinson's disease. Binary Bat Algorithm and Modified Cuckoo Search Algorithm outperformed Particle Swarm Optimization and Genetic Algorithm. Binary Bat Algorithm achieved the best feature subset.

In (Wang et al., 2017), a Firefly Algorithm (ApFA) with adaptive control parameters has been proposed. Experiments on a collection of well-known benchmark issues are carried out to validate ApFA's performance. The ApFA outperforms the normal FA and five other newly suggested FA variations, according to the results.

In (Wei-Jia et al., 2017), a detection algorithm for factors inducing heart diseases based on a particle swarm optimization-support vector machine (PSO-SVM) optimized by association rules (ARs) has been proposed. The AR-PSO-SVM algorithm showed the best classification performance accuracy of 98.96% and can be used to help doctors diagnose and treat heart diseases.

In (Babu et al., 2018), a GWO+ RNN technique has been proposed for medical disease prediction. For feature selection, the GWO technique is employed, which eliminates duplicated and unnecessary characteristics. A RNN classifier based on AE predicts various illnesses while avoiding feature dimensionality problems. In the Cleveland dataset for illness prediction, the GWO + RNN approach enhanced accuracy by 16.825%.

In (Wijaya et al., 2018), a Particle Swarm Optimization Algorithm with Naïve-Bayes Classifier on a heart disease dataset. The result of the accuracy of Naive Bayes increased from 84% to 86.67% when feature selection was done with PSO.

In (Yasen et al., 2018), an Artificial Neural Network combined with Dragonfly Algorithm has been proposed to optimize medical datasets. To evaluate the proposed approach, five medical real datasets have been used. Feature selection was applied to the datasets using the gain ratio method. ANN-DA got the highest accuracy in all but one of the datasets.

In (Freeman et al., 2019), a Kestrel-based Search Algorithm has been proposed, which uses improve rule, check rule, and reduce rule which finds an optimal location. The equirectangular approximation distance value and the respective direction are computed in this study. The reduce rule algorithm reduces and maps each position of nurses to the target location. Here, 100 iterations are performed to find the best solution that guarantees an optimal distance within the search space, and each iteration is synonymous with the location of a nurse.

In (Jabar, 2019), Mutual Information is deployed for feature selection while Firefly Algorithm serves as a feature selection framework; finally, SVM has been used for the classification task. The performance of the method was evaluated on a colon microarray dataset. MI-FA-SVM has an accuracy of 95.12%.

In (Mudaliar et al., 2019), a system has been described whereby using machine learning algorithms like Apriori algorithm, Decision tree, Naïve Bayes, KNN, Logistic Regression, and Gradient Boosting, the authors predict medication for different diagnoses. The Apriori algorithm shows 95% accuracy, 3% more than KNN and 5% more than Decision Tree.

In (Andrushia & Patricia, 2020), the ABC algorithm has been used to select features, with SVM as the classifier. ABC has the benefit of not becoming trapped in its local minimum computation and focusing on both local and global search. The algorithm has a 93.01% accuracy.

In (Kauser & Agrawal, 2020), a hybrid K-Means Firefly Algorithm has been proposed. Davies-Bouldin index was computed after applying the original basic k-means clustering technique, and then the k-means firefly algorithm on diabetes

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 10 Issue 10, October-2021

and iris dataset. The k-means firefly method outperformed the standard k-means algorithm by 54% on average.

In (Manonmani & Balakrishnan, 2020), the Improved Teaching Learning-Based Optimization Algorithm has been suggested where the approach calculates the optimum value of the fitness function by updating the weight of the objective function at each iteration using the Chebyshev distance to discover the best solution at the ith iteration, producing better classification results in the medical data mining field.

In (Vijh et al., 2020), an intelligent lung tumour diagnosis system using whale optimization algorithm and support vector machine has been proposed where WOA finds the best optimal feature subset. The suggested WOA-SVM method has accuracy of 95%, sensitivity of 100%, and specificity of 92%, respectively.

In (James & Blessie, 2021), an Enhanced Feature Selection based on Firefly Optimization (EFS-PO) has been proposed for increasing the prediction of coronary artery disease. The average Accuracy of EFS-PO is 76.944%.

/In (Kumar et al., 2021), a machine learning model using logistic regression for computation prediction has been proposed to predict the risk of COVID-19, heart disease, and diabetes in a person based on answering questions related to factors like travel history, age, gender and blood pressure. The proposed model outperforms the existing models by 1.2746%.

In (Manjula et al., 2021), a new classification system based on the Firefly Binary Cuckoo Search method has been proposed for diagnosing heart disease. The FFBCS classification system is characterized by two subsystems: the BFO feature selection subsystem and the classification subsystem.

In (Rani et al., 2021), a hybridized feature selection method combining the Genetic Algorithm (GA) and recursive feature removal has been proposed for the selection of appropriate features from the dataset. The random forest classifier has been proven to provide the best accurate results for the system. The algorithm was evaluated on a heart disease dataset and scored 86.6% accuracy.

IV. RESEARCH GAPS AND OBJECTIVES

The objective of our research was to:

- Survey existing published literature to identify different published works which were related to nature-based algorithms in healthcare and pinpoint three algorithms that could be used for medicine prediction.
- Identify datasets that could be used with these nature-based optimization algorithms.
- Apply the above algorithms to find accuracy and other parameters to determine the efficiency of each algorithm.
- Select the algorithm which has the most efficiency to find outcomes by inputting symptoms to get a possible diagnosis and drug prediction along with nearby hospital locations.

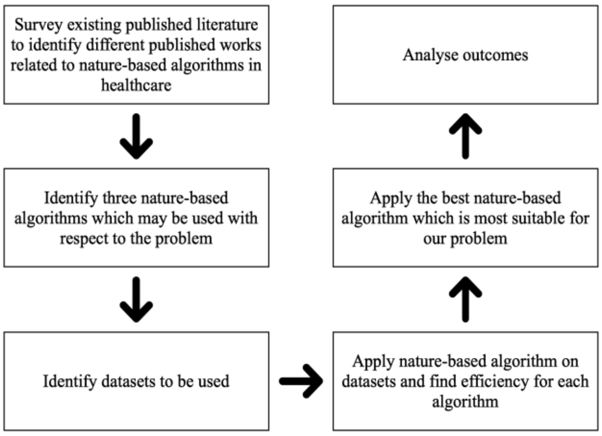

Fig. 1. Implementation for disease and medicine prediction

TABLE I. RESEARCH GAPS IN PRIMARY RESOURCES

S. No.	Paper Title	Algorithm	Advantages	Disadvantages	Performance
1.	Artificial bee colony optimization (ABC) for Grape Leaves Disease Detection	Artificial Bee Colony Optimization Algorithm	ABC does not get stuck in their local minima calculation and takes care of local, global search.	We cannot determine the scope of this algorithm as only one dataset has been used in the study.	The experimental results of the ABC algorithm show an accuracy of 93.01%.
2.	Breast Cancer Diagnosis Approach Based On Meta-Heuristic Optimization Algorithm Inspired By The Bubble-Net Hunting Strategy Of Whales	Whale Optimization Algorithm	The obtained results find out that the proposed features selection algorithm performs better than those presented in the literature.	It used few datasets, so we don't know how it would do with other datasets.	Shows good performance of selected features as it obtains overall 98.77 % accuracy, 99.15 % precision, 98.64 % recall, and 98.9 % f-score.
3.	Disease Prediction And Drug Recommendation Android Application Using Data Mining (Virtual Doctor)	Decision Tree, Naïve Bayes, KNN, Logistic Regression, Apriori Algorithm And Gradient Boosting	The Apriori algorithm is efficient and useful in cases where the patient is unable to consult a doctor.	These algorithms are not as efficient as nature-based optimization algorithms.	The Apriori algorithm shows 95% accuracy, 3% more than KNN and 5% more than Decision Tree.
4.	Feature Selection using Artificial Bee Colony for Cardiovascular Disease Classification	ABC-SVM	The method improves the classifier's prediction performance by optimising the feature selection process and yielding the most optimum feature subset.	We cannot determine the scope of this algorithm as only one dataset has been used in the study.	The experimental results of the ABC-SVM algorithm with the heart disease data showed an accuracy of 86.76%.
5.	An Intelligent Lung Tumor Diagnosis System Using Whale Optimization Algorithm and Support Vector Machine	WOA-SVM	WOA finds the best optimal feature subset.	Cannot improve this algorithm as it already has high accuracy.	The suggested WOA-SVM method has accuracy of 95%, sensitivity of 100%, and specificity of 92%, respectively.

6.	Firefly algorithm with adaptive control parameters	Firefly Algorithm with adaptive control parameters (ApFA)	ApFA does not increase extra loop operations and has the same computational time complexity as standard FA.	ApFA might not give an accurate solution to our problem.	Mean ranks achieved by the Friedman test show that the best mean rank is obtained by the proposed ApFA.
7.	Improving Classifier Performance Using Particle Swarm Optimization on Heart Disease Detection	Particle Swarm Optimization Algorithm with Naïve-Bayes Classifier	PSO provides significant improvement of classifiers' performance.	Only uses one dataset so might not be accurate with our data	The result of the accuracy of Naive Bayes increased from 84% to 86.67% when feature selection was done with PSO.
8.	Link Prediction Based on Whale Optimization Algorithm	Whale Optimization Algorithm	WOA can avoid local optima and get a globally optimal solution.	A possible solution to only the link prediction problem.	Whale Optimization Algorithm has a G-mean of 0.7356, whereas Genetic Algorithm and Differential Evolution Algorithm have G-means of 0.7344 and 0.6532, respectively.
9.	Particle Swarm Optimization Based Incremental Classifier Design for Rice Disease Prediction	Particle Swarm Optimization Algorithm	It can generate classification rules both in a static and dynamic environment.	It might be outperformed by Naïve-Bayes in the case of some datasets.	IPSO produces an accuracy of 93% on average.
10.	Prediction of Coronary Artery Disease Using Enhanced Feature Selection Using Firefly Based Optimization	Enhanced Feature Selection based on Firefly Optimization (EFS-PO)	An operator called rebound-expenditure was developed, based on the attractiveness of the firefly using rebound-expenditure.	We don't know how it would do with our dataset because it only utilised three.	The average Accuracy of EFS-PO is 76.944%.

V. FINDINGS AND DISCUSSION

In India, more than half of the population consists of rural citizens. The healthcare facilities in such areas are harder to access as compared to the developed cities. Patients in such remote locations would benefit from being able to check their symptoms online for a likely diagnosis in this situation. This challenge might be handled by creating a system in which symptoms are fed into an optimization algorithm, which returns drug names, generic alternative medications, and diagnoses as outputs, as well as local hospitals.

We set out to find algorithms that will assist us in making a probable medical diagnosis application. We used the approach of studying already published material on the internet and analysing their characteristic features to evaluate the benefits and demerits of each perspective to choose the three best suitable algorithms for our problem.

TABLE II. NATURE-BASED ALGORITHMS WITH THE HIGHEST ACCURACIES

S. No.	Algorithm	Accuracy
1.	Whale Optimization Algorithm	98.77 %
2.	Artificial Bee Colony Optimization Algorithm	93.01%.
3.	Particle Swarm Optimization Algorithm	93%
4.	Firefly Algorithm	76.94%

After surveying different published works, we identified three nature-based algorithms with high accuracy which could be implemented with our dataset to give us accurate predictions for possible diagnosis and probable medicines along with a list of nearby hospitals. Whale Optimization algorithm, Artificial Bee Colony Optimization algorithm, and Particle Swarm Optimization algorithm are having the highest accuracy of all the literature surveyed.

A. Whale Optimization Algorithm

The Whale Optimization Algorithm is based on the hunting technique of humpback whales. The WOA algorithm begins with a group of individuals who are chosen at random. At each iteration, individuals renew their positions in respect to either a randomly chosen search agent or the best solution achieved thus far. There is a control parameter called A, which is lowered from 2 to zero to allow for exploration and exploitation, respectively. When |A| is greater than one, the best option for updating the position of the search agents is chosen, and when |A| is less than 1, a random search agent is chosen. To balance the exploration/exploitation capabilities, WOA may toggle between a spiral and a circular movement based on the value of another parameter p. The WOA algorithm is finally finished with the acceptance of a termination principle.

B. Artificial Bee Colony Optimization Algorithm

The Artificial Bee Colony Optimization algorithm was developed using honeybee behaviour as a model. Its major objective is to solve math problems as quickly as feasible. In this optimization approach, there are two types of bees: employed bees and unemployed bees. Scout bees and spectator bees are two types of unemployed bees. Bees that scout for new food sources are known as scout bees. Onlooker bees are bees who help the hired bees by sharing information. The employed bees are aware of the food sources, the nest's direction, and the distance between food sources. The employed bees are initially provided with food supplies. The employed bees proceed to the food source and search for nearby sources with sufficient nectar. This procedure is repeated until the termination procedure is completed. Then they'll conduct a waggle dance to show the spectator bees where the food sources are. Onlooker bees dance to get to the food sources. The scout bees are on the lookout for additional new food sources.

C. Particle Swarm Optimization Algorithm

In the Particle Swarm Optimization algorithm, a population of potential solutions, known as a swarm, is represented as particles in the search space. PSO begins with a population of particles that are randomly initialized. The whole swarm travels across the search space, changing its position depending on the experiences of its own and nearby particles to find the optimal answer. In an n-dimensional search space, a particle $X(i)=(x_{(i,1)}, x_{(i,2)},..., x_{(i,n)})$ represents a possible solution to a problem. The particle X(i) has a rate of change of position, which is represented by the velocity $v_{(i,d)}$, where d = 1, 2,..., n. Every particle maintains track of the best place it's ever been in. The particle's prior best position, represented by Bi, is an example of such a record. The best global position G obtained by any particle so far is also kept track of. Iteration entails evaluating each particle and adjusting $v_{(i, d)}$ in the direction of particle X(i)'s the previous best location as well as any particle in its vicinity's previous best position.

PSO is governed by three phases: evaluate, compare and develop. The evaluation step assesses each particle or potential solution's ability to solve the problem. The comparison phase finds the best particles, while the evolve phase creates new particles based on some of the greatest previously discovered particles. This process is continued until a certain halting condition is met. The method's goal is to discover the best particle that provides the best solution to the problem.

The ideas of velocity and neighbourhood topology are crucial in PSO. A velocity vector is assigned to each particle X(i). Every generation, this velocity vector is updated. Following that, the modified velocity vector is utilized to create a new particle X(i). The neighbourhood topology describes how other swarm particles, such as B(i) and G, interact with X(i) to change its velocity vector and, as a result, its position.

VI. FUTURE SCOPE AND CONCLUSION

Nature-based algorithms are a collection of cutting-edge problem-solving methods and methodologies inspired by natural phenomena. Our aim in this survey was to discover three nature-based optimization methods to utilise on our dataset, with the algorithm with the highest accuracy being used to build a medicine predictor in which we feed symptoms into an optimization algorithm and return medication names, generic alternatives, diagnoses and a list of nearby hospitals as outputs. The best accuracies were found in the Whale Optimization algorithm, Artificial Bee Colony Optimization system and Particle Swarm Optimization algorithm, with 98.77%, 93.01%, and 93%, respectively. In future work, we'll use all three algorithms to see which one has the most accuracy using our dataset to develop a medicine predictor.

This work might also be potentially used to forecast various crop diseases. Changes in environmental variables such as temperature, relative humidity, soil moisture, soil pH, soil type, and soil fertility might make crops more vulnerable to disease. These characteristics may be used to forecast whether a crop will be infected or not, as well as what illnesses might impact it and how to prevent or cure damaged crops.

Another possible application can be to predict a machine's health to determine when preventative maintenance is necessary. To identify whether a machine requires preventative maintenance, we may look at parameters like air temperature, process temperature, rotational speed, torque, tool wear, and a machine failure label. The machine failure label shows whether or not the machine has failed and if so, under what circumstances.

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