Volume 3, Issue 7, July 2013 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

A Heuristic Approach to the CHILLI Expert System Using PSO Algorithm

M.Parimala, G.Sumalatha, N.Zareena
Dept. of CSE, VLITS,JNTUK
India

Abstract*— This paper deals with the concepts of expert systems and machine learning Algorithms in the field of Artificial Intelligence. This expert system follows the tactic of task-based specification and it is independent in case of problem solving. Second thing is that, the machine learning technique is used to find the good optimal solution. This paper mainly focuses on the investigations on the diseases and treatment to the diseases which were affected to the chilli plants by using the mechanism Particle Swarm Optimization (PSO) algorithm. PSO is a heuristic global optimization method and also an optimization algorithm, which is based on swarm intelligence.

***Keywords*— Expert System, Swarm, Knowledge Base, PSO, chilli expert system**

I. INTRODUCTION

A. Expert System

An expert system is a software that uses a knowledge base of human expertise for problem solving, or to clarify uncertainties where normally one or more human experts would need to be consulted for giving best. Expert systems have applications in virtually every field of knowledge. The decision areas of expert systems are typically applied to include configuration, diagnosis, interpretation, instruction, monitoring, planning, prognosis, remedy and control. The basic components of an expert system are a "knowledge base" or KB and an "inference engine". The information in the KB is obtained by interviewing people who are expert in the area in question.

B. Types of Expert System

There are many different types of expert systems. The following list describes the various types.*Diagnosis*-Diagnosis types of expert systems are used to recommend remedies to illnesses. Repair-Expert systems that define repair strategies are also very common. As well as diagnosing the problem they can suggest a plan for the repair of the item. *Instruction*-Instructional expert systems have been used for individualized training or instruction in a particular field. Interpretation- Interpretive expert systems have the ability to analyses data to determine its significance or usefulness. *Prediction*- Predictive expert systems are used as a method to "guess" at the possible outcomes of observed situations, usually providing a probability factor. This is used often in weather fore-casting. *Design and Planning*-This allows experts to quickly develop solutions that save time. These systems do not replace experts but act as a tool by performing tasks such as costing, building design, material ordering and magazine design. In Monitoring and Control applications expert systems can be designed to monitor operations and control certain functions. Classification/Identification- systems help to classify the goals in the system by the identification of various features, for example various types of animals are classified according to attributes such as habitat, feeding information, color, breeding information, relative size etc.

C. Expert System Architecture

An expert system is, typically, composed of two major components, the Knowledge-base and the Expert System Shell. The Knowledge-base is a collection of rules encoded as metadata in a file system, or more often in a relational database. As shown in Fig 1, expert system architecture distinctly separates knowledge and processing procedures in the knowledge base and inference engine, respectively. Explicit knowledge is context specific and is easily captured and codified. In expert systems, the inference engine organizes and controls the steps taken to solve the problem.

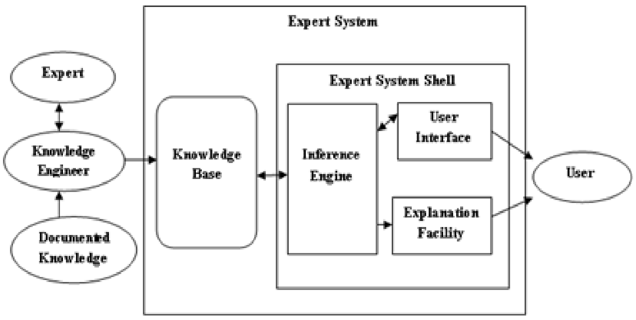

Fig. **1** Expert system Architecture

Once the inference engine determines a solution to the problem, it is presented to the user through the user interface. In addition, explanation facilities in expert systems trace the line of reasoning used by the inference engine to help end-users assess the credibility of the decision made by the system. Often the decisions made by expert systems are based on incomplete information about the situation at hand.

II. PARTICLE SWARM OPTIMIZATION (PSO)

Particle Swarm Optimization (PSO) is a biologically inspired computational search and optimization method developed in 1995 by James Kennedy & Russell Eberhart based on the social behaviors of birds flocking or fish schooling. While searching for food, the birds are either scattered or go together before they locate the place where they can find the food. While the birds are searching for food from one place to another, there is always a bird that can smell the food very well, that is, the bird is perceptible of the place where the food can be found, having the better food resource information. Because they are transmitting the information, especially the good information at any time while searching the food from one place to another, conduced by the good information, the birds will eventually flock to the place where food can be found. As far as particle swam optimization algorithm is concerned, solution swam is compared to the bird swarm, the birds' moving from one place to another is equal to the development of the solution swarm, good information is equal to the most optimist solution, and the food resource is equal to the most optimist solution during the whole course. The most optimist solution can be worked out in particle swarm optimization algorithm by the cooperation of each individual.

The particle without quality and volume serves as each individual, and the simple behavioral pattern is regulated for each particle to show the complexity of the whole particle swarm. This algorithm can be used to work out the complex optimist problems. PSO is initialized with a group of random particles (solutions) and then searches for optima by updating generations, the particles are "flown" through the problem space by following the current optimum particles. Each particle keeps track of its coordinates in the problem space, which are associated with the best solution (fitness) that it has achieved so far.

A. *Particle Swarm Optimization Algorithm*

In the basic particle swarm optimization algorithm, particle swarm consists of "n" particles, and the position of each particle stands for the potential solution in D-dimensional space. The particles change its condition according to the following three principles:(1) to keep its inertia (2) to change the condition according to its most optimist position (3) to change the condition according to the swarm's most optimist position.The position of each particle in the swarm is affected both by the most optimist position during its movement (individual experience) and the position of the most optimist particle in its surrounding (near experience). When the whole particle swarm is surrounding the particle, the most optimist position of the surrounding is equal to the one of the whole most optimist particle.

Each particle keeps track of its coordinates in the solution space which are associated with the best solution (fitness) that has achieved so far by that particle. This value is called personal best , ***pbest***. Another best value that is tracked by the PSO is the best value obtained so far by any particle in the neighborhood of that particle. This value is called ***gbest***. The basic concept of PSO lies in accelerating each particle toward its pbest and the gbest locations, with a random weighted accelaration at each time step as shown in Fig.2

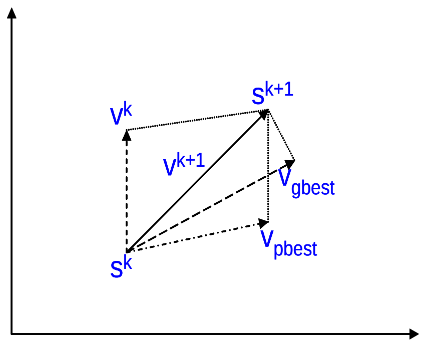

Fig.2 Concept of modification of a searching point by PSO

s^k :current searching point. s^{k+1} :modified searching point. v^k: current velocity.
v^{k+1}: modified velocity. v_{pbest} : velocity based on pbest. v_{gbest} : velocity based on gbest

Each particle tries to modify its position using the following information:

- The current positions
- The current velocities
- The distance between the current position and pbest,
- The distance between the current position and the gbest.

The modification of the particle's position can be mathematically modeled according the following equation :

$$V_i^{k+1} = wV_i^k + c_1 \, rand_1(\ldots) \times (pbest_i - s_i^k) + c_2 \, rand_2(\ldots) \times (gbest - s_i^k) \quad \ldots.. \quad (1)$$

where, v_i^k: velocity of agent i at iteration k,
w : weighting function,
c_j : weighting factor,
rand : uniformly distributed random number between 0 and 1
s_i^k : current position of agent i at iteration k
pbest : pbest of agent i,
gbest : gbest of the group

The following weighting function is usually utilized in **(1)**

$$w = \text{wMax}-[(\text{wMax}-\text{wMin}) \times \text{iter}]/\text{maxIter} \qquad ......\ (2)$$

where wMax= initial weight,
wMin = final weight,
maxIter = maximum iteration number,
iter = current iteration number.

$$\mathbf{s_i^{k+1} = s_i^k + V_i^{k+1}} \qquad ....\ (3)$$

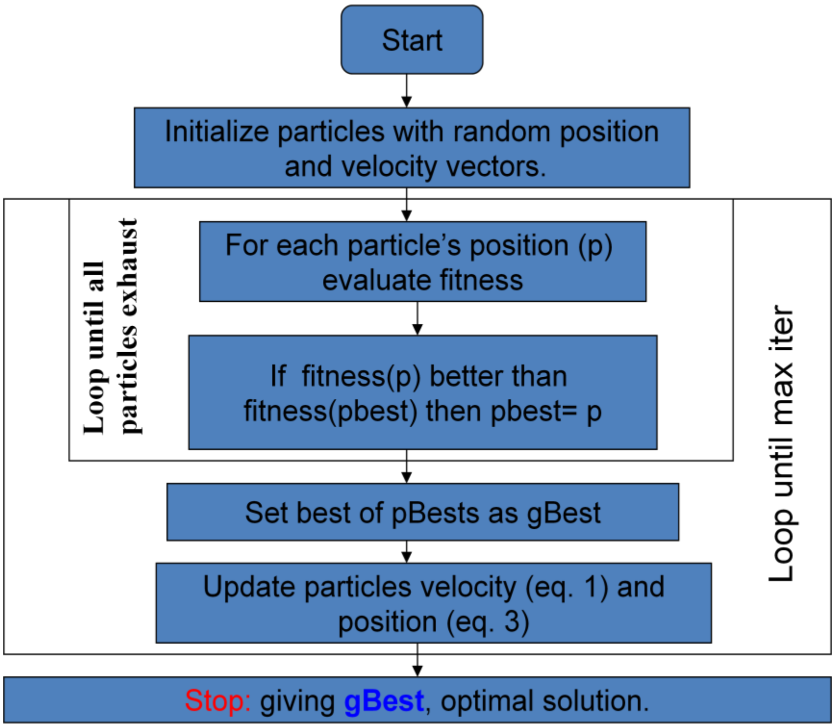

Fig 3:Flow chart of PSO

B. Advantages of PSO

PSO is a population-based search algorithm. This property ensures PSO to be less susceptible in being trapped on local minima. PSO makes use of the probabilistic transition rules and not deterministic rules. Hence, PSO is a kind of stochastic optimization algorithm that can search a complicated and uncertain area. This makes PSO more flexible and robust than conventional methods. PSO can easily deal with non-differentiable objective functions because PSO uses payoff information to guide the search in the problem space. Additionally, this property relieves PSO of assumptions and approximations, which are often required by traditional optimization models. PSO has the flexibility to control the balance between the global and local exploration of the search space.

III. CHILLI EXPERT ADVISORY SYSTEM

In the present system, rules are important for diagnosing a disease in the Chilli plants using machine learning expert system. Here, the rules and rule combinations are prepared according to the data given by the subject experts and stored in the database. Here we had applied a machine learning algorithm such that to get better optimization results in the present Chilli expert system. Here an application of the symptoms in the Chilli plants and flowers were taken and formed into a swarm for diagnosing the diseases in Chilli plants.PSO uses the database for searching the symptom combination given by the user and gives better optimal solutions. Here, our aim is not to get minimal solutions but to get a good optimized better solution.

Following example clearly explains how particles(symptoms) are formed into a swarm moving around in the search space in various iterations looking for the best solution i.e the disease of the chilli plant.

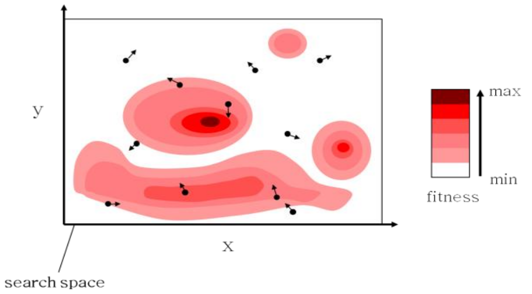

Fig 4 (a): search space in stage1

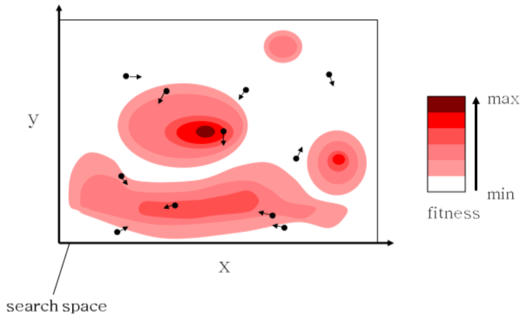

Fig 4 (b): search space in stage2

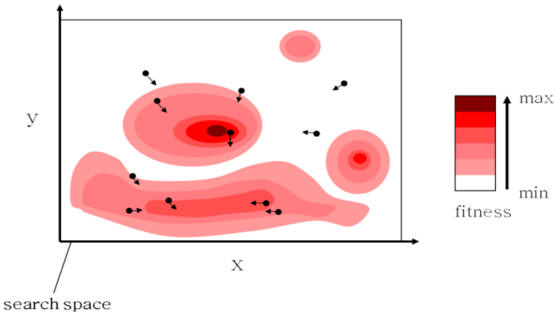

Fig 4 (c): search space in stage3

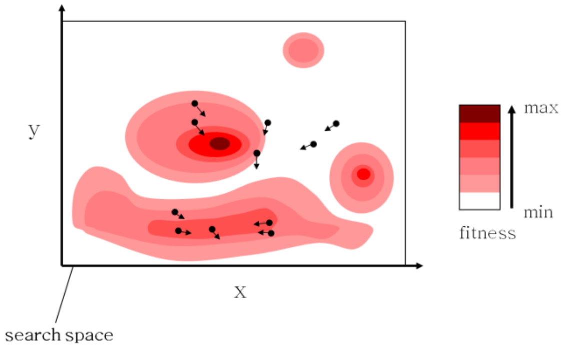

Fig 4 (d): search space in stage4

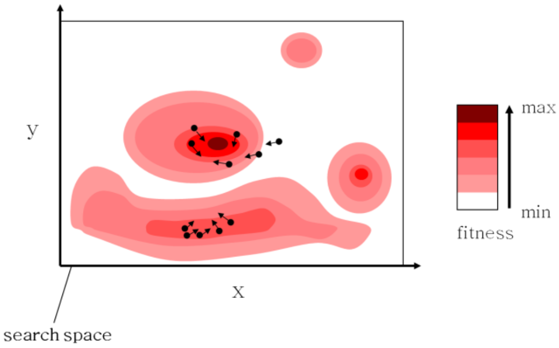

Fig 4 (e): search space in stage5

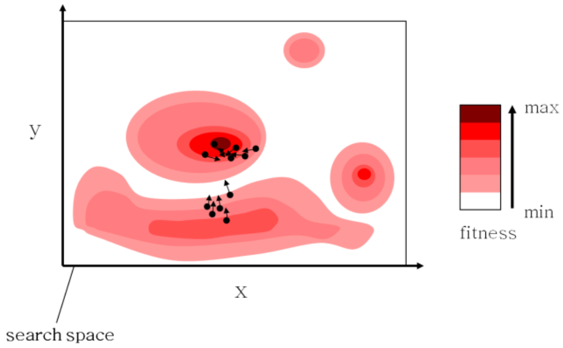

Fig 4 (f): search space in stage6

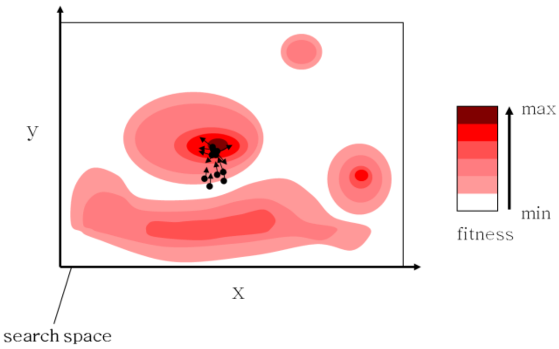

Fig 4 (g): search space in stage7

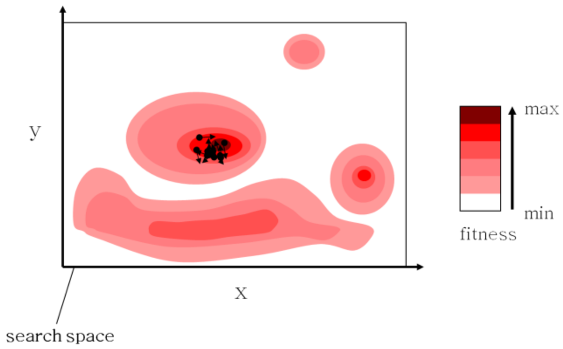

Fig 4 (h): search space in stage8

IV. CONCLUSION

Particle swam optimization is a new heuristic optimization method based on swarm intelligence. Compared with the other algorithms, this method is very simple, easily completed and it needs fewer parameters, which made it fully developed. Advantages of PSO can be combined with the advantages of the other intelligent optimization algorithms to create the compound algorithm that has practical value. At present, the most research on PSO aim at the coordinate system, although in practical usage, it is used in non-coordinate system, scattered system and compound optimization system. The algorithm can be further improved for more complex test problems and applications that subject to extended work.

REFERENCES

[1] R.C. Eberhart and J. Kennedy. A new optimizer using particle swarm theory. In Proceedings of the sixth international symposium on micro machine and human science, volume 43. New York, NY, USA: IEEE, 1995.

[2] R.C. Eberhart and Y. Shi. Particle swarm optimization: developments, applications and resources. In Proceedings of the 2001 congress on evolutionary computation, volume 1, pages 81-86. Piscataway, NJ, USA: IEEE, 2001.

[3] A.P. Engelbrecht. Computational intelligence: An introduction. Wiley, 2007.

[4] J. Kennedy, R.C. Eberhart, et al. Particle swarm optimization. In Proceedings of IEEE international conference on neural networks, volume 4, pages 1942-1948. Perth, Australia, 1995.

[5] R. Poli. An analysis of publications on particle swarm optimization applications. Essex, UK: Department of Computer Science, University of Essex, 2007.

[6] Y. Shi and R. Eberhart. A modified particle swarm optimizer. In Evolutionary Computation Proceedings, 1998. IEEE World Congress on Computational Intelligence., The 1998 IEEE International Conference on, pages 69-73. IEEE, 2002

[7] Angeline P J. (1999). Using selection to improve Particle Swarm Optimization.Proceedings of the 1999 Congress on Evolutionary Computation.

[8] Piscataway. NJ:IEEE Press,1999:84-89.Chen Yonggang,Yang Fengjie,Sun Jigui. (2006). A new Particle swam optimization Algorithm. *Journal of Jilin University*, 2006, 24(2):181-183. (In Chinese)

[9] Clerc M, Kennedy J. (2002). The particle swarm-explosion stability,and convergence in a multidimensional complex space. *IEEE Transactions on Evolutionary Computation*, 2002, 6(1):58-73.

[10] Eberhart R C, Shi Y. (1998). Comparison between genetic algorithms and Particle Swarm Optimization.Porto V W,Saravanan N,Waagen D, et al.Evolutionary Programming VII.[S.l.]:Springer,1998:611-616.

[11] Eberhart R C, Shi Y. (2000). Comparing inertia weights and constriction factors in Particle Swarm Optimization.Proceedings of the Congress on Evolutionary Computating, 2000: 84-88.

[12] Eberhart R, Kennedy J. (1995). A New Optimizer Using Particle Swarm Theory.Proc of 6th International Symposium on Micro Machine and Human Science, Nagoya, Japan. IEEE Service Center Piscataway NJ,1995:39-43.