Volume 1, No. 3, Sept-Oct 2010
ISSN No. 0976-5697
International Journal of Advanced Research in Computer Science
RESEARCH PAPER
Available Online at www.ijarcs.info

A Web-Based Egg-Quality Expert Advisory System using Rule Based and Ant Colony (ACO) Optimization Algorithms

Prof.M.S.Prasad.Babu
Professor
Dept. of CS&SE, Andhra University
Visakhapatnam, Andhra Pradesh, India

J. Anitha*
Lecturer
GIT, GITAM,
Visakhapatnam, Andhra Pradesh, India

N.Thirupathi Rao & Ch. Chandra Sekhar
M.Tech (AI&R)
Dept. of CS&SE, Andhra University
Visakhapatnam Andhra Pradesh, India

Abstract**:** This paper deals with the development of Web based online expert systems using Evolutionary Algorithms. An expert system is a computer application that performs a task that would otherwise be performed by a human expert. Here one of the evolutionary algorithms (ACO Algorithm) is considered to find a good match of symptoms in the database. In the present paper, Ant Colony Optimization[1] (ACO) algorithm has been taken as the base and the concept of optimization is included, so that the new algorithm mainly focuses on the determination of the quality of eggs in the poultry farms. At first, the symptoms provided by the user are processed by a rule based expert system for identifying the quality of the eggs. If the rules required for processing the data by the above are not present in the database, then the system automatically calls the machine learning algorithm technique. As a whole, the system results good optimized solution for recognizing the quality and viruses if any affected to eggs in poultry farms. And corresponding treatments to the viruses may also be suggested to the users. This expert system is designed with JSP as front end and MySQL as backend.

Keywords**:** Expert Systems, Rule Based System, Ant Colony Optimization Algorithm Optimization, Eggs in poultry farms, JSP, MySQL.

1. INTRODUCTION

This paper focuses on the optimization algorithm which gives higher searching efficiency, better optimized and high quality results. An expert system is an artificial intelligence application that uses a knowledge base of human expertise to aid in solving problems, where normally more human experts may be needed for consultation to give a good solution. Expert systems are most common in a specific problem domain, and are traditional application. A vast variety of methods exists at present and can be used to simulate the performance of an expert system. Expert systems may or may not have learning components but once the system is developed it is proven to be placed in the same real world problem solving situation as the human. It can be an aid to human workers or a supplement to some information system.

A. Rule Based Expert Systems

Rule-based systems represent knowledge as a bunch of rules and assertions. It involves a database that stores the assertions and rules that can perform some action (production system) or deduce consequences (deduction systems). The implementation of control over a finite set of assertions allow the systems to dynamically generate new knowledge (forward chaining) and break down a complicated problems into many smaller ones (backward chaining). Unification (matching variables) allows flexibility of the rules, with which the systems can deduce more specific facts (forward chaining) and solve more specific problems (backward chaining) without having a giant set of similar rules. Deduction Systems contains only IF - THEN rules. The system allows the addition of new assertions. If an infinite loop could be created, there will be a stop signal that stop the rule interpretation procedure.

B. ACO Algorithm

Ant Colony Optimization (ACO) metaheuristic is a recent population based approach inspired by the observation of real ants colony and based up on their collective foraging behavior. Ant Colony Optimization (ACO) is a paradigm for designing metaheuristic algorithms for combinatorial optimization problems. A Meta heuristic is a set of algorithmic concepts that can be used to define heuristic methods applicable to a wide set of different problems. Examples of metaheuristics include simulated annealing, tabusearch, iterated local search, evolutionary computation, and ant colony optimization. Meta heuristic algorithms are algorithms which, in order to escape from local optima, drive some basic heuristic: either a constructive heuristic starting from a null solution and adding elements to build a good complete one, or a local search heuristic starting from a complete solution and iteratively modifying some of its elements in order to achieve a better one.

II PROPOSED AOC OPTIMIZED ALGORITHM AND IMPLEMENTATIONS

The different steps of the proposed Rule based Algorithm and Ant Colony Optimization Algorithm can be as follows:

A. Implementation of Rule Based System

Step 1: Rule based algorithm: Pseudo code for the implementation
Step 1.1: Enter the Symptoms to obtain the major viruses.

Let us take two examples
Ex1: 100001010000
From rule 3 s2=1, s5=1, s6=1 and s10=1
Step 1.2: If the exact match symptoms found in the Knowledge base (KB) then Rule based system produce the output
=Virus name as D1
Ex2: 100001000000,
Step 1.3: Exact match symptoms were not there in KB
= Insufficient knowledge it fails and
goes to System 2.

B. Implementation of ACO Algorithm

In ACO, once all ants have computed their solution (i.e. at the end of each iteration) AS Updates the pheromone trail using all the solutions produced by the ant colony. Each edge belonging to one of the computed solutions is modified by an amount of pheromone proportional to its solution value. At the end of this phase the pheromone of the entire system evaporates and the process of construction and update is iterated. On the contrary, in ACS only the best solution computed since the beginning of the computation is used to *globally update* the pheromone. As was the case in AS, global updating is intended to increase the attractiveness of promising route but ACS mechanism is more effective since it avoids long convergence time by directly concentrate the search in a neighborhood of the best tour found up to the current iteration of the algorithm. In ACS, the final evaporation phase is substituted by a *local updating* of the Pheromone applied during the construction phase. Each time an ant moves from the current solution to the next the pheromone associated to the edge is modified in the following way:
Pheromone update:

$$\tau_{i,j}(t+n) = (1-\rho)\tau_{i,j}(t) + \Delta\tau_{i,j}$$

This pheromone updation gives the better results than the general pheromone update formula. Disease will be given depend up on the pheromone update value associated with the disease. In each iteration pheromone update value is updated.

C. ACO Algorithm

Step.1. Set parameters initialize pheromone trails. Pheromone value are associated with disease.
Step.2. while termination conditions not met do.
Step.3. Construct Ant Solutions, Calculate the pheromone value for each disease by the symptom related to that disease.
Step.4. Apply Local Search (optional).
Step.5. Update Pheromones.
Step.6. end while.

D. Optimization in ACO Algorithm

After finding the number of matching symptoms by using the above algorithm, the optimization value is calculated for the matched symptoms by using the following formula,
Step. 1. Optimization value (Opt)
Opt=Sum of the number of Symptoms matched for each disease to be divided by the Total number of symptoms present for each disease in the database.
Step. 2. Best optimization value
The best optimization value for a disease is taken as the global best optimized solution.
Step. 3. Determination of disease
The disease which is having highest Opt is taken and it is submitted to the user by the system as the disease affected to the crop.

III. EGG QUALITY EXPERT ADVISORY SYSTEM

Rules are essential for the implementation of rule based and machine learning expert system for observing the quality and viruses affected to an Egg. The rules and rule combinations are prepared according to the data given by the subject experts and stored in the database in a table format. Here machine learning algorithm is applied to get better optimization results in the egg quality expert system. The present application is consisting of two parts. They are 1. Rule based system and 2. Machine learning system. The Architecture of the Expert Advisory System is as follows:

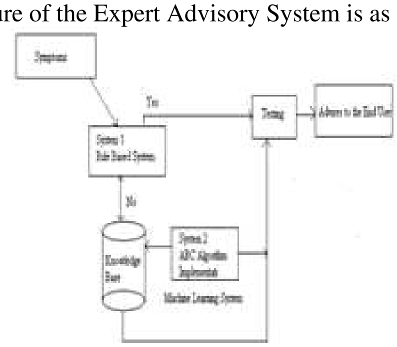


Fig-1: Proposed Architecture for the Egg Quality Expert Advisory System

Here the System1 is Rule based system, where the set of rules are collected from the experts in the relevant field and knowledge base is purely built with rules and facts by taking variables. The system2 is machine learning system which 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. By using this machine learning algorithm we can get a whole optimized better solution at last.

IV. DATABASE GENERATION FOR EGG QUALITY EXPERT SYSTEM

In this section, the setup for production rules in the knowledge base is presented.
Generally the rules are of the form,
Rule 1: S1=1, S2=0, S3=0, S4=0, S5=0, S6=1, S7=0, S8=1, S9=0, S10=0, S11=0, S12=0
Resultant disease may be D1
Rule 2: S1=1, S2=1, S3=0, S4=0, S5= 0, S6=0 ,S7=1, S8=0, S9=0, S10=0, S11=0, S12= 1Resultant disease may be D2
Rule 3: S1=0, S2=1, S3=0, S4=0, S5=1, S6=1, S7=0, S8=0, S9=0, S10=1, S11=0, S12=0 Resultant disease may be D3.
Rule 4: S1=0, S2=1, S3=0, S4=1, S5=0, S6=1, S7=0, S8=1, S9=0, S10=0, S11=1, S12=0
Resultant disease may be D5
Rule 5: S1=0, S2=0, S3=1, S4=0, S5=0, S6=1, S7=0, S8=0, S9=0, S10=1, S11=1, S12=0
Resultant disease may be D2

Rule 6: S1=1, S2=0, S3=1, S4=0, S5=1, S6=1, S7=0, S8=1, S9=0, S10=1, S11=0, S12=1
Resultant disease may be D3
Rule 7: S1=1, S2=0, S3=1, S4=0, S5=1, S6=1, S7=1, S8=1, S9=0, S10=1, S11=0, S12=1
Resultant disease may be D6
Rule 8: S1=1, S2=0, S3=1, S4=0, S5=1, S6=1, S7=1, S8=1, S9=0, S10=1, S11=0, S12=1
Resultant disease may be D4
Rule 9: S1=1, S2=0, S3=1, S4=0, S5=1, S6=1, S7=1, S8=1, S9=0, S10=1, S11=0, S12=1
Resultant disease may be D8
Rule 10: S1=1, S2=0, S3=1, S4=0, S5=1, S6=1, S7=1, S8=1, S9=0, S10=1, S11=0, S12=1
Resultant disease may be D3
Rule 11: S1=1, S2=0, S3=1, S4=0, S5=1, S6=1, S7=1, S8=1, S9=0, S10=1, S11=0, S12=1
Resultant disease may be D5
Rule 12: S1=1, S2=0, S3=1, S4=0, S5=1, S6=1, S7=1, S8=1, S9=0, S10=1, S11=0, S12=1
Resultant disease may be D5
Rule 13: S1=1, S2=0, S3=1, S4=0, S5=1, S6=1, S7=1, S8=1, S9=0, S10=1, S11=0, S12=1
Resultant disease may be D3
Rule 14: S1=1, S2=0, S3=1, S4=0, S5=1, S6=1, S7=1, S8=1, S9=0, S10=1, S11=0, S12=1
Resultant disease may be D5
Rule 15: S1=1, S2=0, S3=1, S4=0, S5=1, S6=1, S7=1, S8=1, S9=0, S10=1, S11=0, S12=1
Resultant disease may be D2
Rule 16: S1=1, S2=0, S3=1, S4=0, S5=1, S6=1, S7=1, S8=1, S9=0, S10=1, S11=0, S12=1
Resultant disease may be D3
Rule 17: S1=1, S2=0, S3=1, S4=0, S5=1, S6=1, S7=1, S8=1, S9=0, S10=1, S11=0, S12=1
Resultant disease may be D2
Rule 18: S1=1, S2=0, S3=1, S4=0, S5=1, S6=1, S7=1, S8=1, S9=0, S10=1, S11=0, S12=1
Resultant disease may be D4
Rule 19: S1=1, S2=0, S3=1, S4=0, S5=1, S6=1, S7=1, S8=1, S9=0, S10=1, S11=0, S12=1
Resultant disease may be D1
Rule 20: S1=1, S2=0, S3=1, S4=0, S5=1, S6=1, S7=1, S8=1, S9=0, S10=1, S11=0, S12=1
Resultant disease may be D2

By using these rules, the system can generate the solution accordingly the rule declared and if the particular rule is not declared in the database then the system goes for a machine learning expert system which is using the machine learning algorithm for its working given by the step by step procedure in Section 2.

V. RESULTS & DISCUSSIONS

Report 1

In this screenshot, the user can see the static data about eggs and poultry farms

Fig 2: Selection of System

Report 2

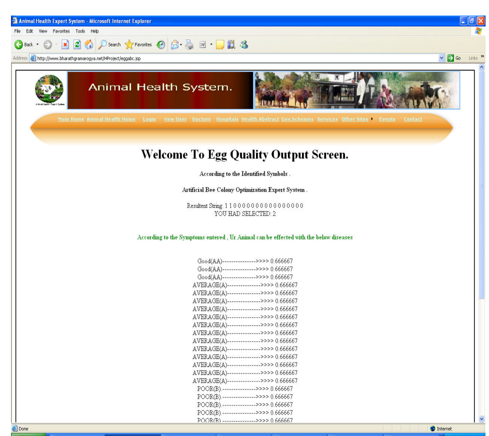
In this screenshot, the user selects the symptoms from the following:

Fig 3: Machine Learning Expert System

1. Foliage brown in color is present? Yes or No
2. Greyish violet in color of leaves present? Yes or No
3. Greyish violet in seeds present? Yes or No
4. Lesions Violet to purple present? Yes or No
5. Leaves fold over present? Yes or No
6. Cool temperature present? Yes or No

Report3

In this screenshot, the user can see the following.



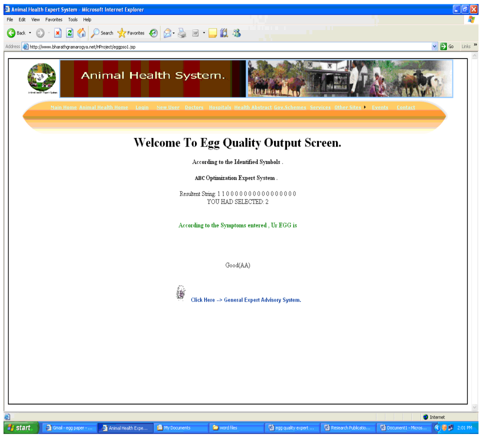


Fig4: Result from the Machine Learning Algorithm with Optimization Values and the quality of the egg as "Egg Quality is good"

VI. CONCLUSIONS

The present system results better compared to the system developed based on the rule based algorithm alone. The implementation of the proposed system also gradually reduces the processing time of rules and gives the solution to the problem in a more optimized level. The algorithm used in the system can be treated as quite effective, in most cases it finds a solution which represents a good approximation to the optimal one and fast enough for the number of iterations. By the thorough interaction with the users and beneficiaries the functionality of the system and the AOC Algorithm can be extended further to many more areas. The audio and video files may be added to the user interface to make the system more user friendly. The results are tested by placing the present developed system in the web portal www.bharathgramarogya.net/newindex.html.

VII. REFERENCES

[1] M. Dorigo and L. M. Gambardella "Ant colony system: a cooperative learning approach to the traveling salesman problem", IEEE Transactions on Evolutionary Computation1, Vol.1, 1997, pp.53-66.

[2] M. Dorigo, V. Maniezzo and A. Colorni, "The ant system: optimization by a colony of cooperating agents", IEEE Transactions on Systems, Man and Cybernetics Part B, Vol.26,1996, pp.29-42.

[3] L M Gambardella and M .Dorigo, "Solving symmetric and asymmetric TSPs by ant colonies", Proceedings of the IEEE International Conference on Evolutionary Computation (ICEC′96), Nagoya Japan, 1996, pp.622-627

[4] V. Maniezzo, A. Colorni. "The ant system applied to the quadratic assignment problem." IEEE Transactions on Knowledge and Data Engineering, Vol.11, No.5, pp.769-778, 1999

[5] A. Colorni, M. Dorigo, V. Maniezzo. "Distributed optimization by ant colonies." Proceeding of First European Conference on Artificial Life, Paris, France, pp.134-142, 1992.

[6] B. Bilchev, I.C. Parmee. "The ant colony metaphor for searching continuous design spaces." Proceedings of the AISB workshop one evolutionary computation, Berlin: Springer, pp.25–39, 1999.

[7] J. Dréo, P. Siarry. "A new ant colony algorithm using the heterarchical concept aimed at optimization of multiminima continuous functions." Ant algorithms

[8] Proceedings of ANTS 2002-Third international workshop, Berlin: Springer, pp.216–219, 2002.

[9] J.L. Ding, Z.Q. Chen, Z.Z. Yuan. "On the combination of genetic algorithm and ant algorithm." Journal of Computer Research and Development, Vol.40, No.9, pp.1351-1356, 2003.

[10] L.J. Sun, R.C. Wang. "Solving QoS multicast routing problem based on the combination of ant colony algorithm and genetic algorithm." Acta Electronica Sinica, Vol.34, No.8, pp.1391-1395, 2006

[11] Liu Yezheng, Ling Haifeng, Yang Shanlin, "Recent progress of ant colony optimization and its applications," Journal of Hefei University of Technology .2006, 29(1): 41-44.

[12] Chen Youjian, Chen Zuojian, "Improvement of ACA and its simulation on TSP,"

[13] www.indiakisan.net

[14] www.bharathgramarogya.net

[15] www.bharathgramarogya.net/newindex.html

[16] www.indg.in/agriculture