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An efficient Particle Swarm Optimization technique for identification of shortest path in Distributed Network

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***Abstract*—** Optimization problems under uncertainty are complicated and complex, often conventional algorithmic approaches based on mathematical and dynamic programming are able to solve only few problem instances. Particle Swarm Optimization or Ant Based Systems are used as latest Swarm Intelligence algorithms used for finding suitable low cost route. Here in this paper the various ant based techniques are implemented such as Max-Min, Rank based and Fuzzy based systems, although the techniques provide shortest route in some cases and also contains some limitations such as optimization of next route or wrong rank from one node to another. Hence on the basis of limitations of the above ant based techniques a new methodology is implemented which provides better path and less time complexity.

***Keywords*—** *Particle Swarm Optimization, Shotest Path, Ant Colony Optimization, Swarm Intelligence.*

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I. INTRODUCTION

Swarm Iintelligence (SI) is an inventive, distributed and intelligent method of problem solving for optimal principal. Particle Swarm Optimization (PSO) can be implemented and applied easily to solve various function of optimization problems, PSO's main strength is its fast convergence then all other existing global optimization algorithm like Genetic Algorithm, Simulated Annealing etc. PSO is a heuristic global optimization approach which was brought in to concept by Doctor Kennedy and Eberhart in 1995 [1].The phenomena was observed by looking at the behavior of the birds for collecting food. The PSO is a heuristic universal optimization method and also an optimization algorithm technique located forward formerly by [1], which is based on swarm intelligence that is behaviors of bird flocking. PSO become skilled from the circumstances and has been used to explain the optimization problems. In PSO, each distinct clarification is a "bird" in the exploring space, which is known as "particle". Each particle has its own fitness values which are evaluated by the fitness function to be optimized, and velocities which expresses the flying of the particles. These particles fly all the way through the difficulty space by following the existing optimum particles.

PSO has been practically used extensively in the function optimization, pattern recognition, artificial neural network training, fuzzy control and some other applications. Even though the fact that PSO has extended for uninterrupted optimization difficulty at the start, but now there are some descriptive works focused on discrete problem. For example use of PSO algorithms to resolve network routing [2] [3]. On the other hand, the PSO algorithm has slow convergence rate in the afterward phase and straightforwardly trapped in local optimum. Up to the present, a little work has been done on using PSO to work out any cast related routing problem (ARP) with multiple QoS constraints. The new thought to be appropriating intelligence which make possible the nodes to acquire choices and bring out the routing of the packets successfully. PSO has accomplished to find the optimal path with capable nodes. PSO is a method of optimizing the candidate results iteratively and trying to progress towards the final result. The resources involved in the implementation of such an algorithm is less and it can be easily used for a real-time environment. The maximization of quality properties for solving optimal path is not seriously considered in today's network scenario. The introduction of quality grading is found to be helpful in obtaining quality property maximization while generating routing optimization.

With the growth of information world and computer networking, it is critical issue to perform efficient routing. The issue leads to enhance the performance and speed of network. Multicast is a communication technique over the IP infrastructure in a network for one-to-many communication. QoS uses resource reservation control mechanisms to allow administrators to set a desired level of service for each traffic type on the network. The main aim of QoS is to offer preferential delivery service for the applications that need it by ensuring sufficient bandwidth, reducing data loss, and controlling latency & jitter. PSO is a stochastic and population based advanced computer algorithm for problem solving. It is based on socio-psychological principles and involves insights into social behavior [4].

PSO is initialized with a group of uniformly distributed random particles. Each particle searches for optima by updating generations. PSO algorithm has a higher convergence rate and convergence faithfulness, and it is near to the global

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optimum than the original PSO algorithm under some performance test functions. PSO is a population based

Natural behavior of ants.

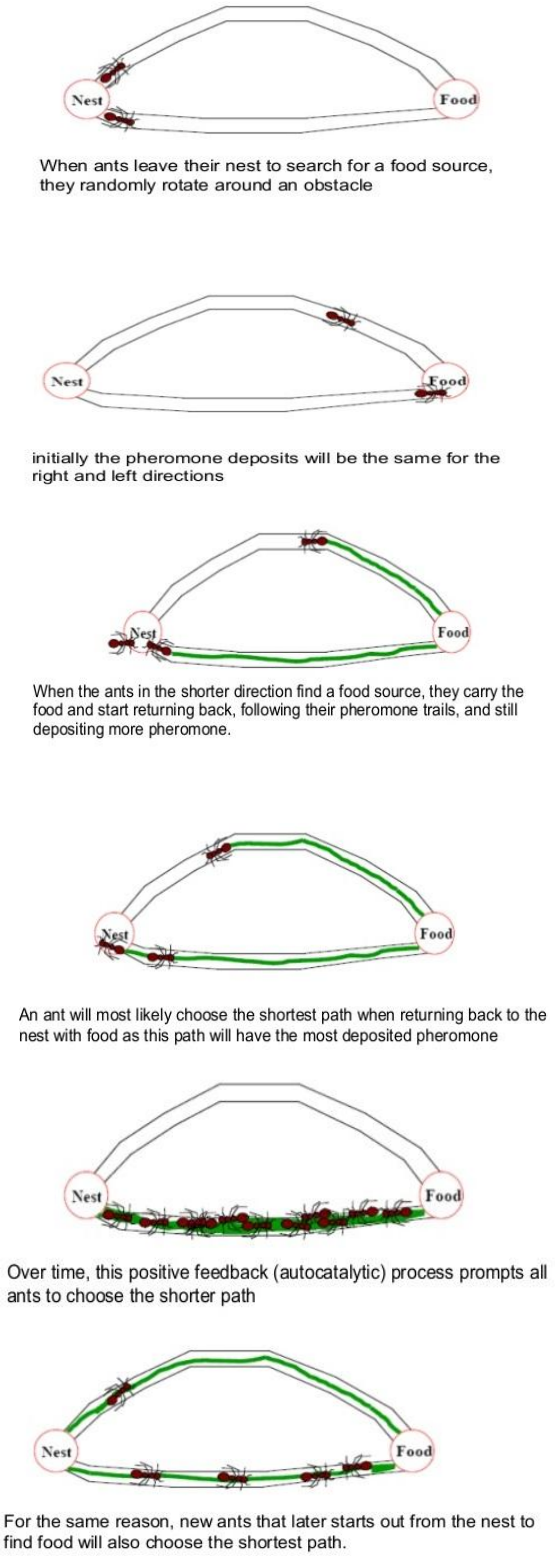

Figure 1. Ants searching food.

stochastic optimization technique inspired by the social behavior of bird flocking or fish schooling. If one sees a desirable path to go the rest of the swarm will be able to follow quickly evSen if they are on the opposite side of the swarm [7]. Ant Colony Optimization (ACO) is based on the behavior of ants seeking a path between their colony and a source of food. This concept is based on the methods of ant finding their food and path to get back their home. When an ant moves it drop some amount of pheromone that is evaporated after some time. If another ant followed same path pheromone get richer in quantity. More value of pheromone means maximum ants followed the path. By following this path they can easily find their source or destination. Thereby, each such ant incrementally constructs a solution to the problem [8]. In a computer science and operation research, the ant colony optimization algorithm (ACO) is a probabilistically techniques for solving computational mathematical problem which can be reduced to find good path through a graph. Ant Colony Optimization (ACO): a Swarm intelligence method have been applied to many combinatorial optimization difficulty, ranging from quadratic task to collapse protein or routing vehicles and a lot of derived methods have been adapted to dynamic problems in real variables, stochastic difficulty, multi-targets and parallel executions.

PSO moves towards the global optimal solution by taking into consideration the local solutions of the particles. The computational cost involved is very low and it is ideally suited for very large input cases. Thus, PSO can be easily used to solve the Quality of Service problems etc. The rest of paper is organized as follows. Section II contains description of background. Section III contains description of related work of PSO, IDS and Routing. Section IV included proposed method. Section V describes about experimental result algorithm followed by a conclusion in Section VI.

II. BACKGROUND

Conventional optimization methods were needed huge computational attempts, which grow exponentially as difficulty dimension enhances with the networks of independent nodes. Researchers continuously working upon the challenges like communication link failures, low memory, calculating constraints, and maximum valued energy. A lot of problems may formulated and approached through multidimensional optimization problems, in which most nodes are not neighbors of one another, but can be reached from every other by a small number of hops. On the rapid changes to sustain multimedia applications in wireless network, it is popular that such network maintains multicast connection for the whole session during connection establishment. Multicast routing uses multimedia Internet applications and live video streaming. Hence we need an efficient implementation of this routing technique which has low computational cost and good

performance. Genetic Algorithms (GA) and Ant Colony Optimization (ACO) techniques have been used to solve these problem. PSO can be easily used to handle a large number of test cases and possible solutions for a given problem.

III. RELATED WORK

This section describes some related work to intrusion detection system, routing and particle swarm optimization.

Mala and Rajagopalan suggested Quality of Service (QoS) multicast routing problem using Particle Swarm Optimization technique. They used fitness function to implement the constraints specified by the Quality of Service conditions. They found shortest path using fitness function to generate most possible optimal solutions. According to their suggested method first they tried to discover all possible routes with respect to source node. These paths are stored in vectors and used for later implementation. One path is chosen randomly from each node and is used to form a tree, this constitutes a particle. The number of particles is chosen depending on the size of the input. The fitness function used is a minimization function. Every particle in the system has a personal best value associated with it, which is pbest. This value of pbest represents the best fitness value obtained by the particle when applied to the fitness function. Also, a global best value known as gbest, is used to store the best fitness function value obtained among pbest values of all particles in the system. The personal best of each particle is compared with the value returned by the fitness function. If the value of fitness function is lesser, then the personal best of the particle is set to the value of fitness function. When the personal best value of each particle is calculated, the value of global best is updated as the value of all the personal best values [4].

Group Method for Data Handling based networks for intelligent intrusion detection were presented by Baig et al. [5]. They described about the problem of network intrusion detection and Group Method for Data Handling (GMDH). Group Method for Data Handling (GMDH)-based networks was used for intelligent classification of network traffic. Such type of intelligent computing techniques are also used in educational testing, pattern recognition and spam mail classification. Unlike regression-based techniques, the GMDH technique does not require user intervention for specifying the model relationship or the architecture of the neural network a priori. This scheme can work in two phases. First phase contains selection of the most appropriate network traffic features. Phase two responsible for the network traffic is classified as being either normal or anomalous through the use of GMDH-based networks. They also introduced three prominent statistical ranking techniques, to identify the most relevant network traffic features for the dataset. GMDH network-based approach used for classification of network traffic into normal or anomalous. The GMDH approach is a proven concept for iterated polynomial regression that can generate polynomial models for a given dataset using effective predictors. The iterative process involves using initially defined simple intra-data regression relationships, to derive more accurate representations in subsequent iterations of the technique. The number of independent variables, i.e. features that are combined for generating the appropriate models is varied in each step, and the technique is known to perform well even in the presence of a small subset of independent variables in the generated models [5].

Hsieh et al. [7] applied particle swarm optimization to schedule order picking routes in a distribution center. The modified PSO algorithm has a higher convergence rate and convergence reliability, and it is closer to the global optimum than the original PSO algorithm under four performance test functions. They attempted to use PSO to solve route planning problems of an order-picking system in a distribution center. An important part of the PSO algorithm is particle velocity and particle position. In each iteration solution, each particle is updated by two best values. The first one is the best solution it has achieved so far, which is pbest. Another value that is tracked by the particle swarm optimizer is the best value obtained so far by any particle in the population, called gbest. The PSO adaptability function evaluated the optimum particle position to obtain the shortest possible picking route [7].

Zhang et al. [8] presented a framework that aims to combine the two approaches in intrusion detection and therefore, to reach a better system performance. They tried to combine benefits of both SVM and Ant Colony Optimization. They proposed the combination of the two algorithms to develop a new intrusion detection system. The idea is to use the SVM to find the support vectors and generate a hyper plane that separates normal and abnormal data while CSOACN is used to find data added to active SVM training set and finally generate models for normal data as well as for each class of abnormal data. The clustering process is divided into several clustering periods by clustering around certain objects each time. A binary classifier (i.e. SVM classifier) for intrusion detection has been constructed by the result generated in SVM training phase. The classifiers can be modified gradually by repeating the three steps: SVM training phase, ant clustering phase and constructing the classifier. On the other hand, the CSOACN training mode is suitable for the preciseness intensive case and can solve multiclass problems upon both label and unlabeled data. The CSVAC mode, which is based on the combination of SVM and CSOACN, can be used to balance the performance of IDS in terms of efficiency and accuracy [8].

Kong et al. [9] proposed a new ant colony optimization (ACO) approach, called binary ant system (BAS), to Multidimensional Knapsack Problem (MKP). Different from

other ACO-based algorithms applied to MKP, BAS uses a pheromone laying method specially designed for the binary solution structure, and allows the generation of infeasible solutions in the solution construction procedure. A problem specific repair operator is incorporated to repair the infeasible solutions generate in every iteration. Pheromone update rule has been designed in such a way that pheromone on the paths can be directly regarded as selecting probability. To avoid premature convergence, the pheromone re-initialization and different pheromone intensification strategy depending on the convergence status of the algorithm were incorporated. Experimental results provided the advantages of BAS over other ACO-based approaches for the benchmark problems selected from OR library [9].

Multi-objective optimization formed realistic model for many more complex engineering problem. Different type of genetic algorithms solution have been provided to solve these problems. A new Swarm Intelligence based on Genetic Algorithms (SIGA) [10] has been proposed to overcome the disadvantage faced in the previous approaches. The exampled problems chosen was Multiple-objective human's resource allocation problems. These problems has already been solved by hybrid genetic algorithm. They found newly proposed SIGA which is outperformers then previous processes. Swarm intelligence based genetic algorithm for solving multi-objective optimization proposed by Aravindhu and Sathya [11] overcomes the disadvantages of the previous approaches. A group (swarm) of particles moves in discrete intervals through the search space. Particles represent solution instances in the search space. Each particle keeps track of the best solution it encountered in its path which is called as the local best. The best location identified by all particles is called as the global best. The next move of the particles is controlled by the particle best and the global best. SIGA obtained best pare to optimal solutions when compared to moHGA [11].

Vamshidhar Reddy et al. [12] implemented ACO based heuristic approach for Location Routing Problem (LRP) in bill delivery services for the telecommunication company in Hong Kong. The proposed algorithm has statistically proven its effectiveness for solving the practical problem in LRP and the results obtained are comparable with the existing heuristics. In comparison with the existing solution methodologies for the problem considered, the uniqueness of the ACO-based heuristic lies in its constructive approach which exploits an indirect form of memory of previous performance to discover the best near-optimum solution efficiently. The new thing they found in the proposed ACO-based heuristic is that the ants carry out both allocations and routing simultaneously; whereas the existing algorithms perform the allocation using some other heuristics like TA and SA [12].

Zhu Lin et al. [13] presented a network security model built on the integration of data stream mining and intrusion detection system. Data collection module is mainly responsible for the lossless capture of network packets, and meanwhile in charge of some simple packet inspection as well as filtration of error messages. The data which the data collection module submits to the pretreatment layer are basically the original data packets. Cluster analysis divides the concentrated data objects into a number of groups, making the similarity of data in each group as high as possible while making the similarity among groups as low as possible. This data mining algorithm is used to extract security-related attributes of systematic characteristics, and then to generate classification models of security incidents in accordance with these attributes so as to effectively reduce the uncertainty caused by human factors in analyzing intrusion patterns and extracting characteristics, thus achieving an automated screening of security incidents [13].

In year 2012 Cheng-Yuan Ho et al [14] proposed "Statistical Analysis of False Positives and False Negatives from Real Traffic with Intrusion Detection/Prevention Systems. This mechanism is beneficial for false positive/negative assessment with multiple Intrusion Detection Systems, Intrusion Protection Systems to collect False Positive and False Negative cases from real-world traffic and statistically analyze these cases. False Positives and False Negatives of the IDS/IPS are mystery terms that illustrate a situation where the IDS/IPS makes a mistake. The former means that the IDS/IPS triggers an alert when there is no malicious activity in the traffic while the latter means that there is no alert raised by the IDS/IPS when malicious traffic passes through it. The evaluation is important to IDS/IPS developers trying to optimize the correctness of detection by reducing both False Positives and False Negatives, because the False Positives / False Negatives rate limits the performance of network security systems due to the base-rate fallacy phenomenon [14].

Mustafa Amir Faisal et al [15] proposed Securing Advanced Metering Infrastructure Using Intrusion Detection System with Data Stream Mining. This regards IDS as a second line security solution after firewall, cryptography, and authorization techniques etc. which are first line security procedures. This IDS design consists of three local IDSs placed in smart meters, data concentrators, and central system (AMI head end). For detecting anomaly it uses data stream mining approach on the public KDD CUP 1999 data set for analysis the requirement of the three components in AMI. They proposed architecture for IDS in AMI which is more reliable, dynamic, and considers the real time nature of traffic. Moreover simulate the data analysis of IDS in each component of AMI. As per result, the concurrent stream mining algorithms can meet the restrictive resource requirements like

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memory in smart meters. In accumulation emphasize dedicated IDS along with other security measures for smart meter. The reason is this security measures will enhance the comprehensive security, dependability, and even anticipation the attacks against AMI. Several obvious issues like characteristic of traffic in AMI, coordination among the IDSs, registering dynamic device to smart meter, etc come in spotlight in [15].

IV. PROPOSED ALGORITHM

Assume a network is setup and a number of packets send from source to destination and the value of pheromone deposited at each nodes and shortest path is selected using Max-Min, Rank based and Fuzzy System.

```
If N->pkts send from one node to other nodes
Compute next node based on Max-min ();
Compute next node based on Rank();
Compute next node based on Fuzzy();
Repeat till 'N' packets send from source to destination
For each N->pkt to traverse from nod1-> nod2
If Vpher->nod2 == Vpher -> nod3v && If Rnod2 > Rnod3
&& Rnod4<Rnod3
Stores the path from nod2 -> nod3
End
End
Repeat for each N->pkt from 'S' to 'D'
Call Max-Min();
Call Rank();
Call Fuzzy();
Traverse the nod1 -> nod2 based on stored path.
End
End
End
```

Here in the proposed methodology the shortest route from source to destination will depends on the stored routes from Max-Min, Rule based and Fuzzy based System.

At each step of the node in the network instead of checking of only two nodes the next possible path from 3 ant based techniques is checked and if the chances of traversing fails to apply then the next traversing path is stored, which is then used in the proposed methodology.

The proposed methodology uses the wrong traversed routes from one to another where the decision is based on only values from one node to another.

V. SIMULATION RESULT

In the simulation result the comparative study of earlier algorithms that is Max-Min algorithm, Rank Based algorithm and Fuzzy Based algorithm with the proposed algorithm has been shown in the form of a table as well as graph to better understand the difference of time taken by the various algorithm to find the shortest path

No. of packets	Min-Max	Rank Based	Fuzzy Based	Proposed
2	10	13	18	8
4	26	36	32	18
6	35	39	36	28
8	21	32	34	19
10	39	43	48	32
15	57	54	59	48
20	85	83	89	73

Table 1.1 Comparison of time taken by Max-Min, Rank Based, Fuzzy Based and Proposed Algorithm

The Table 1.1 is representing the number packets has been chosen to travel across the network and the corresponding time required by various algorithms. As shown in table the proposed algorithm is taking smallest time to search the shortest path from source to destination

As shown in graph, proposed algorithm having highest number of pheromones remained in each travel (different number of packets in each travel). That means less pheromones evaporated in proposed algorithm because value of pheromones deposited is equal in for each algorithm and number of pheromones evaporated is also equal for each algorithm. But the value of pheromone evaporated and deposited can be different. To better understand suppose number of pheromones deposited is 8 for all three algorithms and number of pheromones evaporated is 5. These pheromones are evaporated with time so the algorithm which remains with largest number of pheromones in the last that must have taken smallest time to search shortest path. The proposed algorithm have largest number of pheromones so it has taken smallest time to search shortest path.

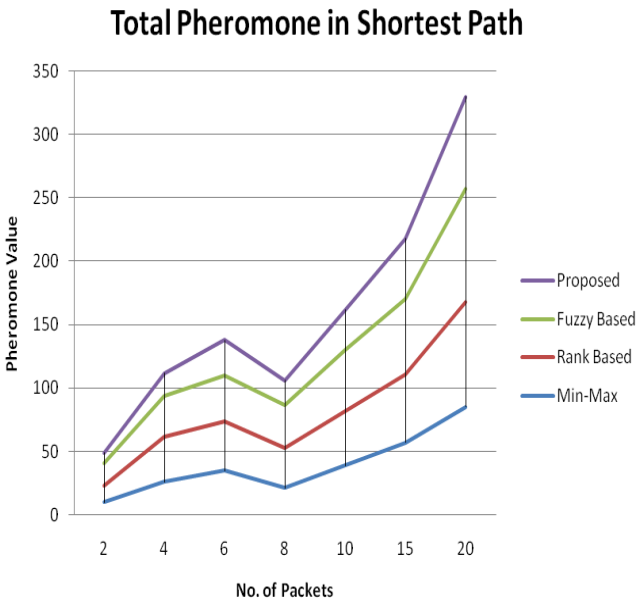

Figure 2. Graph for comparative study of proposed algorithm with Min-Max, Rank Based and Fuzzy Based algorithm.

VI. CONCLUSION

The proposed methodology implemented here for the shortest path from Source to destination is implemented. The proposed methodology can be used in the wired or wireless network but cloud computing is one of the best application of the methodology where data from cloudlet to datacenters via brokers is stored through the shortest route. The technique is efficient since it is implemented on the basis of limitations of other ant based techniques. Also the methodology provides better and optimized path and less time complexity.

VII. REFERENCES

[1] Kennedy, J. and Eberhart, R., "Particle swarm optimization," in Proceedings of the IEEE International Conference on Neural Networks, VSol. 4, pp. 1942–1948, 1995.

[2] J. W. Wang, X. W. Wang, M. Huang. "An Intelligent QoS Multicast Routing Algorithm under Inaccurate Information". Computational Intelligence and Security. In 2006 International Conference on Publication, pp. 073-1077, 2006.

[3] J. W. Wang, X. W. Wang, M. Huang. "A Hybrid Intelligent QoS Multicast Routing Algorithm in NGI". In Sixth International Conference on Parallel and Distributed Computing Applications and Technologies (PDCAT'05), pp. 723-727, 2005.

[4] Mala, C., A. Anurag Mahesh, R. Aravind, R. Rajgopal, Narendran Rajagopalan, and B. Nithya. "Simulated Study Of Qos Multicast Routing Using Genetic Algorithm." National Institute Of Technology, Tiruchirappalli. World Applied Programming 2, no. 5,pp 342-348,2011.

[5] Baig, Zubair A., Sadiq M. Sait, and AbdulRahman Shaheen. "GMDH-based networks for intelligent intrusion detection", ELSEVIER Engineering Applications of Artificial Intelligence, Vol. 26, issue 7, pp. 1731–1740, 2013.

[6] Sonawane, Sandip, Pardeshi, Shailendra and Prasad, Ganesh "A survey on intrusion detection techniques World Journal of Science and Technology, Vol. 2, issue 3, pp.127-133, 2012.

[7] Hsieh, Ling-Feng, Chao-Jung Huang, and Chien-Lin Huang. "Applying particle swarm optimization to schedule order picking routes in a distribution center." Asian Journal of Management and Humanity Sciences, Vol. 1, no. 4, pp. 558-576, 2007.

[8] Zhang, Qinglei, and Wenying Feng. "Network intrusion detection by support vectors and ant colony." In Proceedings of the 2009 International Workshop on Information Security and Application, pp. 639-642. 2009.

[9] Kong, Min, Peng Tian, and Yucheng Kao. "A new ant colony optimization algorithm for the multidimensional Knapsack problem." Computers & Operations Research, Vol. 35, no. 8, pp. 2672-2683, 2008.

[10] N .Aravindhu "Swarm Intelligence based Genetic Algorithm for Multi-Objective Optimization" International Journal of Recent Trends in Engineering, Issue. 1, Vol. 1, May 2009.

[11] Aravindhu, N. and Sathya, S. Siva "Swarm Intelligence based Genetic Algorithm for Multi-Objective Optimization", International Journal of Recent Trends in Engineering, Issue. 1, Vol. 1, pp. 211 – 214, May 2009.

[12] Vamshidhar Reddy, M., Vinay V. Panicker, and R. Sridharan. "Ant colony optimisation for location routing problem and its application to bill delivery services." *International Journal of Logistics Systems and Management*, Vol. 14, no. 1, pp. 1-37, 2013.

[13] Zhu Lin and Zhu- Can- Shi "Research into the Network Security Model Blended of Data Stream Mining and Intrusion Detection System", in Proceedings of the IEEE 7th International Conference on Computer Science & Education (ICCSE 2012), pp. 498 – 499, 2012.