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Implementation on Particle Swarm Optimization Algorithm

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Abstract: Particle swarm optimization is a an optimization algorithm, which is based on swarm optimization. It is study from the research on the birds and fish flock movement behavior. PSO is widely used algorithm and rapidly developed for its easy implementation. The main working principle of PSO is represented in this research paper; analysis of PSO algorithm; the advantages and the shortcomings are summarized. At last this paper presents some kinds of improved versions of PSO and research situation, and the future research issues are also given.

Keywords: Particle swarm optimization Algorithm.

1. Introduction

Particle swarm optimization is a global optimization method, proposed by Doctor Kennedy and Eberhart in 1995. It is developed from swarm optimization and is based on the research of bird and fish movement behavior , When search the food. The birds are scattered and go together at where locate the place from there they can find the food. When the birds are going for search food from one place to another then always there is a bird that can smell the food very well. That is the bird is cognizable of that place from where the food can be found. That bird have a good food resource information. The good information at any time while searching the food from one place to another is transmitting by the bird, that path is conduced by the good information. The birds will flock to the place where food can be found through the good information collections of birds. When particle swarm optimization algorithm is applied and calculated , swarm optimization is compared to the bird swarm optimization, the birds are moving from one place to another is equal to the development of the calculated swarm that means good information and food resource is equal to the optimist solution during the whole course.

This whole theory is implemented over the network of computer then this become a great theoretical and on practical work, which is main course of this research paper. The PSO is mainly applied on networking , this is very useful to find out shortest and reliable path between the nodes. In the networking PSO is used to transfer the data and packets from one place to

another. The proposed algorithm intends to provide security. The Secure Compromising path Algorithm provides a foundation for governing a secure communication system for mobile ad hoc networks. PSO improved safe routing approach to transfer data from congestion free and attack safe path. Generally, the shortest path is the most favourite area for the attackers to perform the intrusion, but the presented approach will not cover any node that is having the higher probability of the attack or the congestion. As the communication will be performed over a congestion free path, the energy and the delay over the network will be reduced. The presented approach is effective in terms of energy and the time as well as provide a reliable route over the network.

2. Analysis of Particle Swarm Optimization

The effective transmission of packets is a requirement for the provision of advanced communication performance makes finding shortest network paths essential. Routing data packets through the shortest path (SP) is an efficient approach to increase the Quality of Service (QoS) in expanding networks as it minimizes cost or delay while maximizing quality or bandwidth.

Therefore, finding the SP is in routing a significant approach for the new and emerging technologies, particularly, video-conferencing and video on demand which require high bandwidth, low delay and low delay jitter. Variation of SP routing problems have to be solved to achieve advanced communication in a wide variety network problems such as K-shortest paths , constrained shortest-path , multiobjective shortest path and so on. Most of these problems are NP-hard and many algorithms have been developed to find the lowest cost or SP routing from a specific source to specific destination through a network. Particle Swarm Optimization (PSO) is another effective meta-heuristic approach to solve search space network problems with a priority encoding method being applied to represent valid paths for the routing paths.

The Particle Swarm Optimization algorithm is based on certain social behaviors observed in flocks of birds, schools of fish, etc., from which certain aspects of intelligence emerge. After its development by Kennedy and Eberhart [13] in 1995, this evolutionary paradigm has been seriously studied on and grown in the past decade. The standard PSO model consists of a swarm of particles, moving interactively through the feasible problem space to find new solutions. Each particle has a position represented by a position vector; where *i* is the index of the particle, and a

velocity represented by a velocity vector. Each particle remembers its own best position so far in the vector p_{best} and the best position vector among the swarm is stored in a vector g_{best} the search for the optimal position (solution) advances as the particles' velocities and positions are updated. In every iteration, the fitness of each particle's position is calculated using a pre-defined fitness function and the velocity of each particle is updated using the *gbest* and *pbest* which were previously defined.

A particle's velocity and position are updated as follows:

$$v_{id} = wv_{id} + c_1 r_1(p_{Best} - x_{id}) + c_2 r_2(g_{Best} - x_{id});$$

$$i = 1,2,\ldots..,N \text{ , and } d = 1,2,\ldots.,D$$

$$x_{id} = x_{id} + v_{id}$$

Particle Swarm Optimization optimizes an objective function by undertaking a population – based search. The population consists of potential solutions, named particles, which are metaphor of birds in flocks. These particles are randomly initialized and freely fly across the multi dimensional search space.

The various steps involved in Particle Swarm Optimization Algorithm are as follows:

Step 1: The velocity and position of all particles are randomly set to within pre-defined ranges.

Step 2: Velocity updating – At each iteration, the velocities of all particles are updated according to,

$$v_i = v_i + c_1 R_1 (p_{i,best} - p_i) + c_2 R_2 (g_{i,best} - p_i)$$

where p_i and v_i are the position and velocity of particle i, respectively; $p_{i,best}$ and $g_{i,best}$ is the position with the 'best' objective value found so far by particle i and the entire population respectively; w is a parameter controlling the dynamics of flying; R_1 and R_2 are random variables in the range [0,1]; c_1 and c_2 are factors controlling the related weighting of corresponding terms. The random variables help the PSO with the ability of stochastic searching.

Step 3: Position updating – The positions of all particles are updated according to,

$$p_i = p_i + v_i$$

After updating, p_i should be checked and limited to the allowed range.

Step 4: Memory updating – Update $p_{i,best}$ and $g_{i,best}$ when condition is met,

$$p_{i,best} = p_i \quad if\ f(p_i) > f(p_{i,best})$$

$$g_{i,best} = g_i \quad if\ f(g_i) > f(g_{i,best})$$

where f(x) is the objective function to be optimized.

Step 5: Stopping Condition – The algorithm repeats steps 2 to 4 until certain stopping conditions are met, such as a pre-defined number of iterations. Once stopped, the algorithm reports the values of g_{best} and $f(g_{best})$ as its solution.

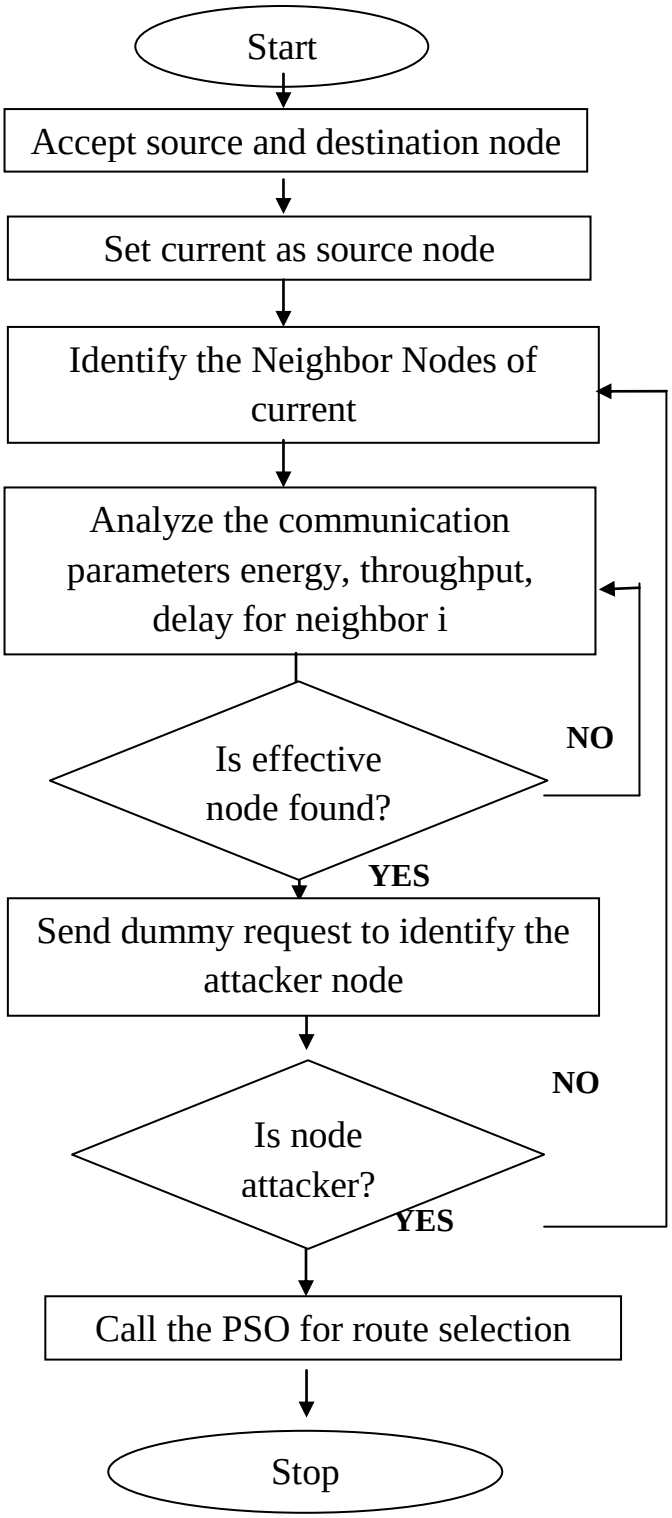
PSO utilizes several searching points and the searching points gradually get close to the global optimal point using its pbest and gbest. Initial positions of pbest and gbest are different. However, using thee different direction of pbest and gbest, all agents gradually get close to the global optimum.

3. Swarm Optimization Algorithm :

In this work, the parameteric analysis is performed on each node to identify the best neighbor. The parameters considered here are the throughput analysis, energy, delay analysis on each node. As the parameters are identify for all the neighbours, best neighbour is selected from the list. Now it will check the node for valid node. As the reply is obtained from this best node effectively. Set this node as the best neighbour and the communication will be performed over that node. If reply is not accurate, the attacker node is identified. In such case the PSO will be called to perform the safe communication.

3.1 flow Chart Of Swarn Optimization Algorithm

The algorithmic approach of the work is shown in figure



Effective Routing Algorithm

3.2 Algorithm

1. Define N Number of mobile Nodes in the network with specific parameters in terms of energy, transmission rate etc.
2. Define the Source and the Destination node over the network
3. Set CurNode as the current node
4. Find M Neighbor Nodes of Nodes CurNode and Maintains the respective Information

   For (j=1 to M)

   { Energy(Neighbor(i))

   Distance(Neighbor(i))

   Load(Neighbor(i))

   Throughput(Neighbor(i))

   Delay(Neighbor(i)) }

4 if Throughput(Neighbor(i))<Threshold and TimeDelay < Threshold1

   /* Reliable node identify*/

   { For i=1 to Mi

   { CollectInformation(Ni, Neighbor(Ni)); }}

5. implement Forward SWARM to find the alternate path in each Direction of Neighbour(N(i)).
6. Set the Pheramon on Each Hop and Identify the Possible Path
7. Implement Backward SWARM to inform Neighbour Nodes about Backup Path
8. Trace the Pharamons and Commmunicate of New Path
9. Perform the Normal Communication

The description of the Swarm concept is presented here

1. At regular interval any node s(Source) is selected to send data to some destination node d.

2. Each forward Swarm selects the next hop nde using the routing table information. the next node selected depends on some random scheme. If all nodes already visited a uniform selection will be performed

3. If the selected node is some attack or damage node or it is not currently available. the forward Swarm wait to turn in the low priority node from the queue.

4. It will identify any of the next non visited node and pay some delay on it.

5. If some cycle detected the Swarm is forced to turn on the visited node.

6. When the Swarm reaches the destination node a backward Swarm is generated to transfer all its memory.

7. Backward Swarm uses same path generated by forward Swarm.

By default route is chosen on the basis of Path selection formula and i.e. we will choose the lowest energy path. It means every time the selected path is using lowest energy. In case there is problem in the selection of the path then we apply the Swarm Algorithm the purpose of which is to continue sending data using the previous path (as from Path selection Algorithm).

Hence we achieved efficiency in terms of energy by applying path selection whereas Swarm Optimization Algorithm gives the required reliability.

4. Advantages and Disadvantages of the PSO Algorithm:

Advantages of the basic particle swarm optimization algorithm:
i. PSO is based on the intelligence that can be applied on engineering uses and scientific research.
ii. PSO does not overlapping and mutation calculations. The search can be carried out by the speed of the particle they transmit information from one to another and the speed of the researching is very fast.
iii. The calculation in PSO is very simple. Compared with the other developing calculations, it occupies the bigger optimization ability and it can be completed easily.

Disadvantages of the particle swarm optimization algorithm:

i. The method easily suffers from the partial optimism, which causes the less exact at the regulation of its speed and the direction.

ii. The method can not work out the problems of scattering and optimization.

iii. The method can not work out the problems of non-coordinate system.

5. Implementation of PSO Algorithm:

5.1 NETWORK DESIGN

The proposed work is about to find the optimal solution of any broken link or data loss in a high speed Wireless LAN. The proposed work is about the generation of such an approach that will dynamically compensate the problem of link failure and provide the optimize solution without any data loss.

The proposed system will give the benefit in terms of Efficiency and accuracy. The network is designed with some defined parameters given as

Scenario 1

Parameter	**Value**
Number of Nodes	10
Topography Dimension	100 m x 100 m
Traffic Type	CBR
Topology	Random
Initial Node	1
Destination Node	10

The proposed work is about to introduce a compromising path to transfer data from some safe route if there are some chances of occurring of any intrusion or the congestion in the route of the basic routing algorithm.

The proposed algorithm is shown in previous chapter. The results obtained from the work are shown here

5.1.1 Results

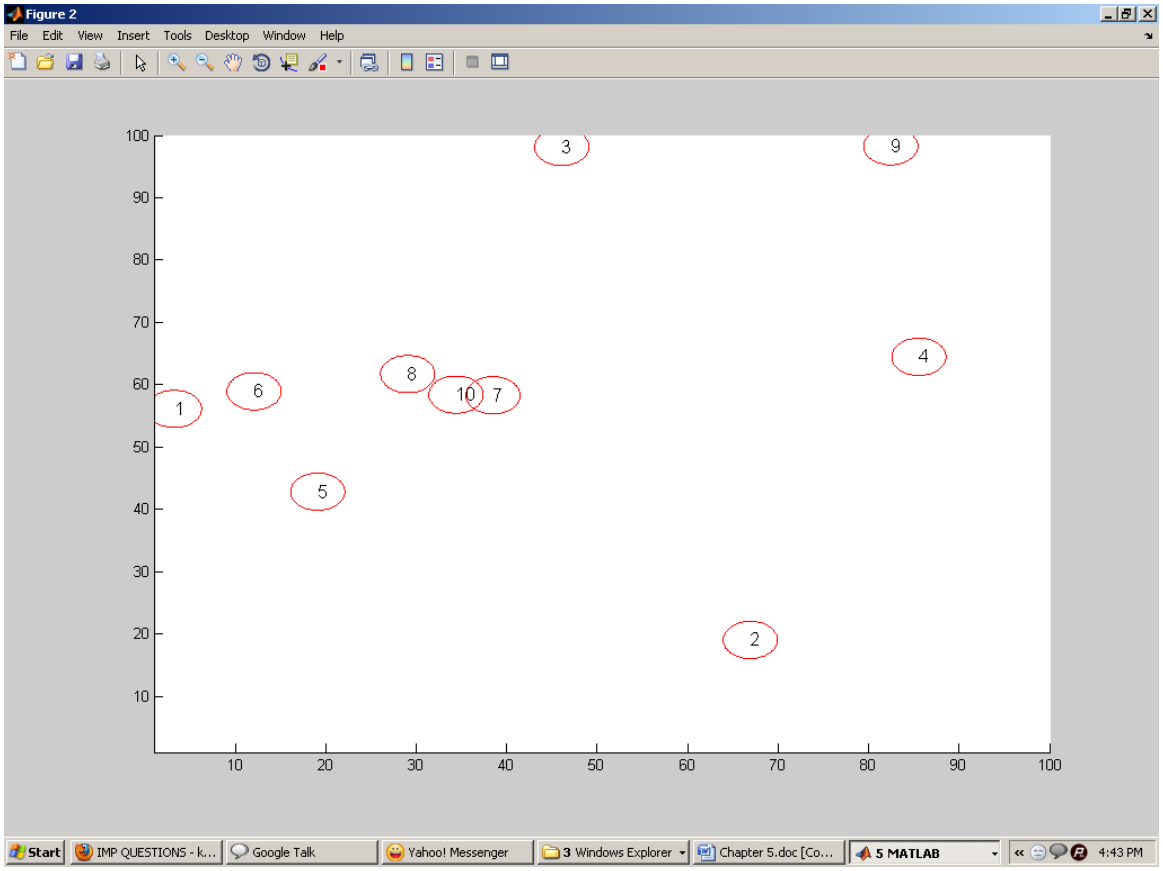


Figure : Network Architecture

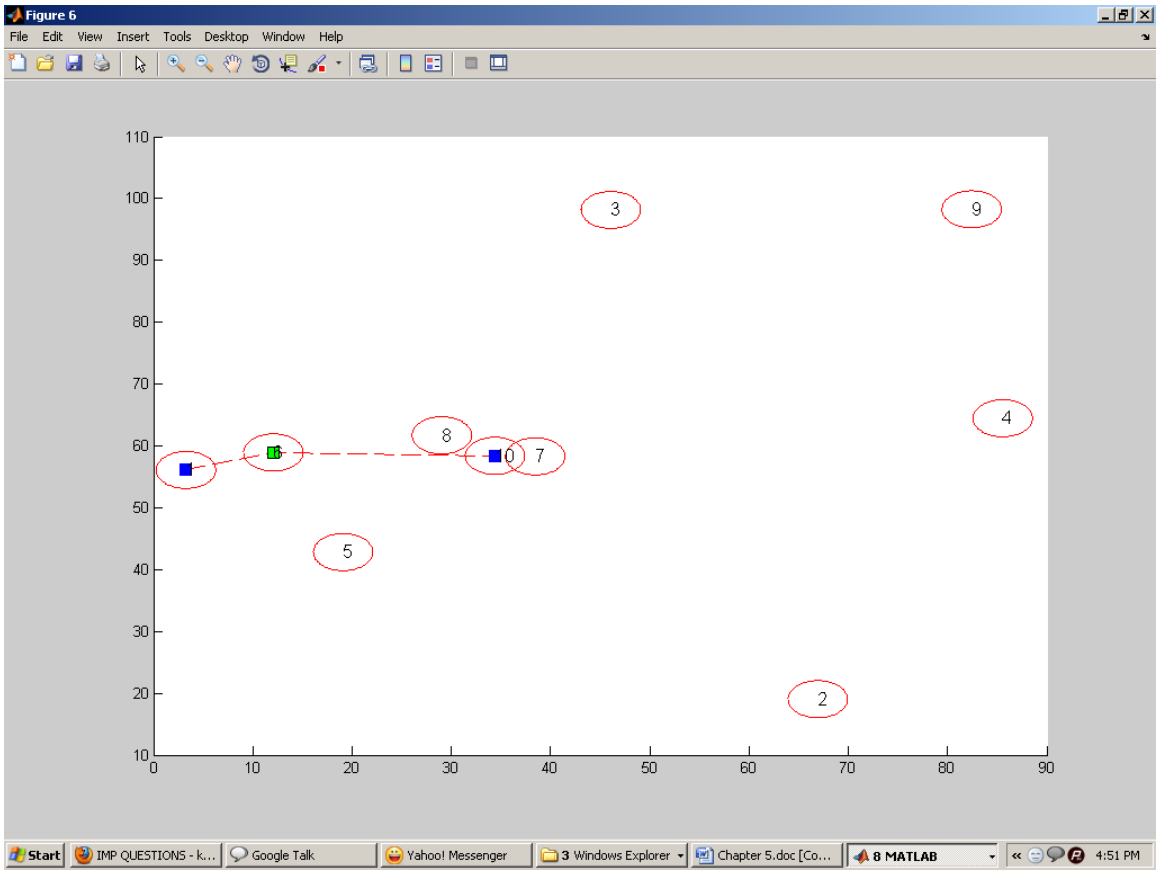
In figure we can see that the network is defined with 10 number of nodes. As we can see the nodes are numbered from 1 to 10. Blue nodes are showing source node and the destination node. All other nodes are the intermediate nodes.

The proposed PSO Improved algorithm has defined an intruder safe compromising path that will not cover any node of shortest path and will return a safer path to the user.

The results driven from the Compromising path Algorithm gives the path

1 => 6 => 10

The connectivity is shown in figure



Generated Path (Proposed Work)

Scenario 2

Parameter	**Value**
Number of Nodes	30
Topography Dimension	100 m x 100 m

Traffic Type	CBR
Topology	Random
Initial Node	1
Destination Node	30

The proposed work is about to introduce a compromising path to transfer data from some safe route if there are some chances of occurring of any intrusion or the congestion in the route of the basic routing algorithm. The proposed algorithm is shown in previous chapter. The results obtained from the work are shown here

5.1.2. Results

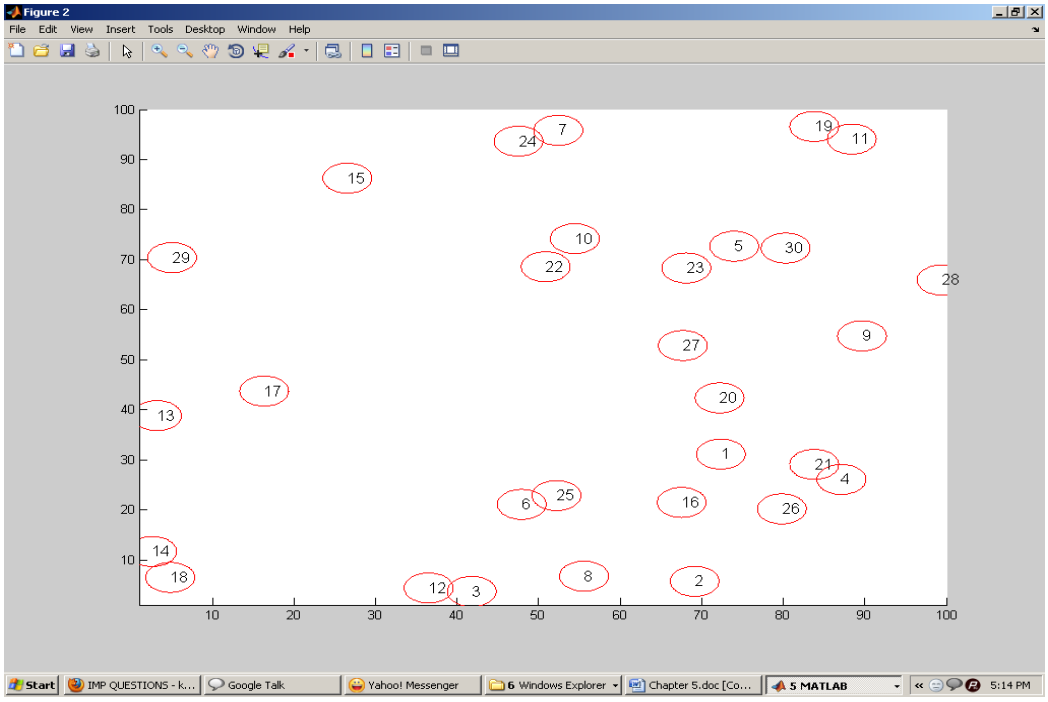


Figure : Network Architecture

In figure we can see that the network is defined with 30 number of nodes. As we can see the nodes are numbered from 1 to 30. Blue nodes are showing source node and the destination node. All other nodes are the intermediate nodes.

The proposed PSO Improved algorithm has defined an intruder safe compromising path that will not cover any node of shortest path and will return a safer path to the user. The results driven from the Compromizing path Algorithm gives the path

1 => 23 => 2 => 26 => 30

The connectivity is shown in figure

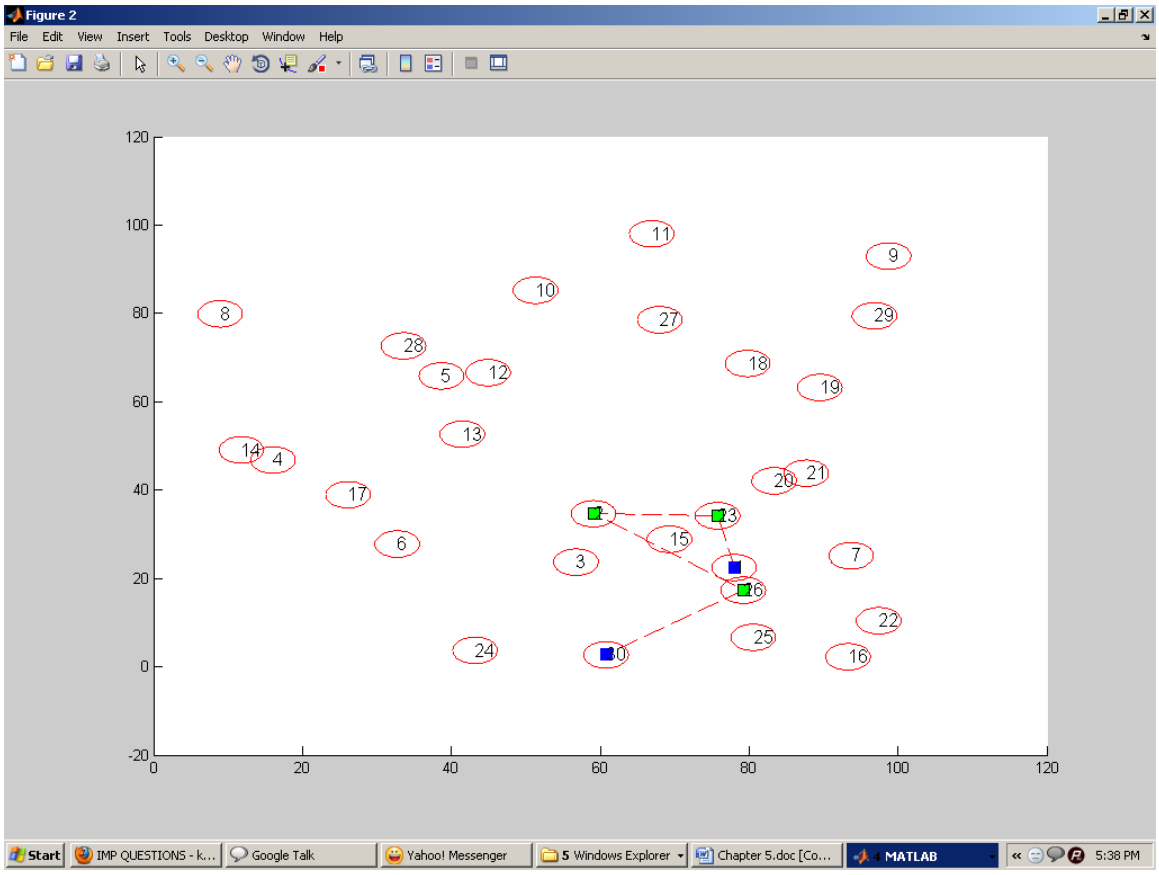


Figure Generated Path (Proposed Work)

Scenario 3

Parameter	**Value**
Number of Nodes	50
Topography Dimension	100 m x 100 m
Traffic Type	CBR
Topology	Random
Initial Node	1
Destination Node	30

The proposed work is about to introduce a compromising path to transfer data from some safe route if there are some chances of occurring of any intrusion or the congestion in the route of the basic routing algorithm. The proposed algorithm is shown in previous chapter. The results obtained from the work are shown here

5.1.3. Results

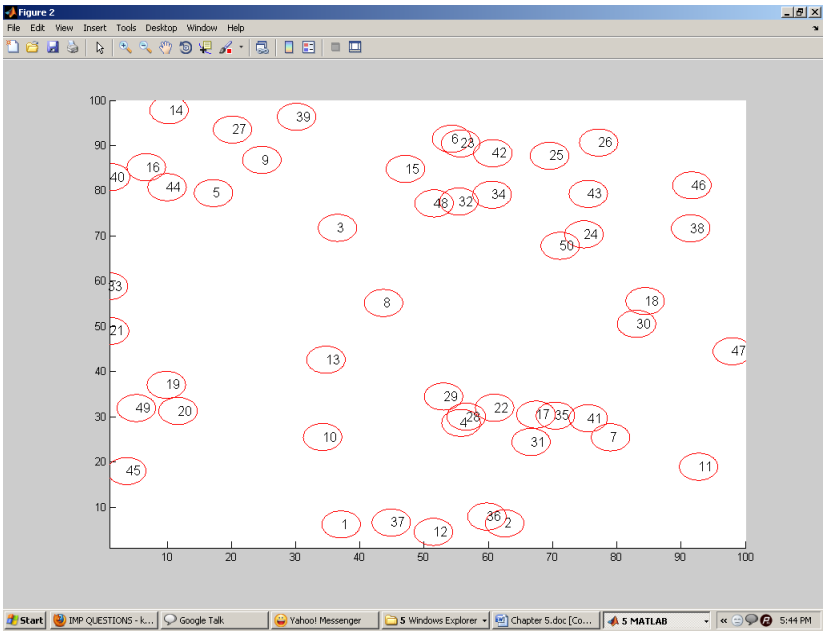


Figure :Network Architecture

In figure we can see that the network is defined with 30 number of nodes. As we can see the nodes are numbered from 1 to 30. Blue nodes are showing source node and the destination node. All other nodes are the intermediate nodes.

The proposed PSO Improved algorithm has defined an intruder safe compromising path that will not cover any node of shortest path and will return a safer path to the user.

The results driven from the Compromizing path Algorithm gives the path

1 => 12 => 29 => 28 => 22 => 30

The connectivity is shown in figure

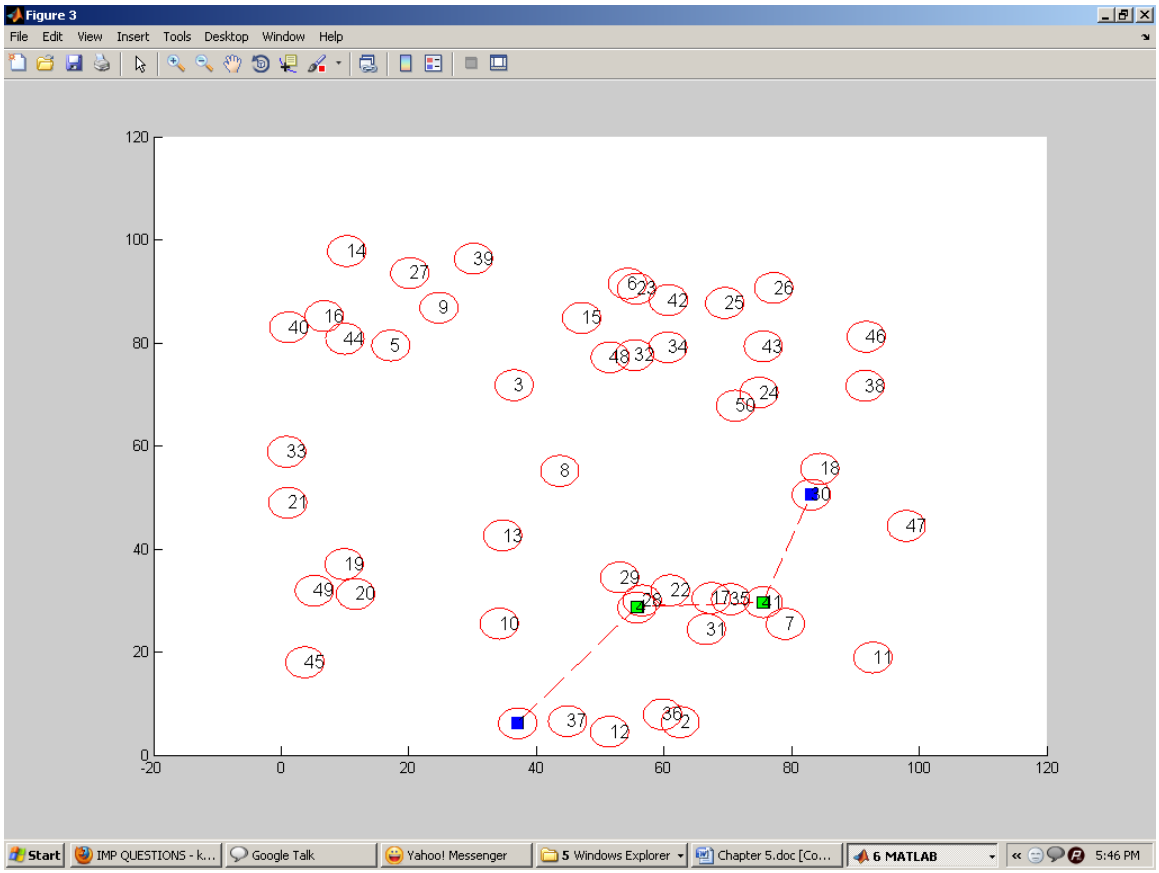


Figure : Generated Path (Proposed Work)

6. The Conclusion and the Future Research on PSO

Particle swam optimization is heuristic optimization algorithm which is based on swarm intelligence.when it Compared with the other algorithms or methods, this method is very simple, easily completed and implemented and it needs fewer parameters to implementation, that make it fully developed. However, the research on the PSO method have so many problems in the beggning but after a short time period they are resolved.

The research on PSO will be mainly focus on the following:

a. PSO have problem in theoeitical foundation but in practically PSO does not have any problems and PSO's application has been proved. Clerc and Kennedy make a analysis on the PSO method from the point of math's. By the analyzing they find out the limited conditions where the particle can move stably. Based on this analysis , Bergh more analysis on PSO. Also Lebesgue and Borel explain the effect of casualty on the locus of the particle, and analyze the convergence from the point of measuring space.

b. Research on the topology of the new pattern particle swarm which has a better function can be carried out. The neighboring topology of the different particle swarms are based on the imitation of the different societies. It is meaningful to the use and spread of the algorithm to select the topology to enable PSO have the best property and do the research on the suitable ranges of different topologies.

c. Blending PSO with the other intelligent optimization algorithms means combining the advantages of the PSO with the advantages of the other intelligent optimization algorithms to create the compound algorithm that has practical value..

d. The effect can be found out in the practical application. Although the PSO algorithm has been used widely, it will be very meaning to explore the developing area further. 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, there is less research on the PSO algorithm application in these systems.

REFERENCES

1. Angeline P J. (1999). Using selection to improve Particle Swarm Optimization.Proceedings of the 1999 Congress on
2. Evolutionary Computation.Piscataway. NJ:IEEE Press,1999:84-89.
3. Chen Yonggang,Yang Fengjie,Sun Jigui. (2006). A new Particle swam optimization Algorithm. *Journal of Jilin University*, 2006, 24(2):181-183. (In Chinese) Clerc M, Kennedy J. (2002)
4. . 4. The particle swarm-explosion stability,and convergence in a multidimensional complex space. *IEEE Transactions on Evolutionary Computation*, 2002, 6(1):58-73. Clerc M. (1999).
5. The swarm and the queen:towards a deterministic and adaptive particle swarm optimization.Proceedings of the Congress on Evolutionary Computation. Piscataway,

NJ:IEEE Service Center,1999:1951-1957. Colorni A, Dorigo M, Maniezzo V, et al. (1991).

6. Distributed optimization by ant colonies. Proceedings of the 1st European Conference on Artificial Life,1991:134-142. Dorigo M,Maniezzo V, Colorni A. (1996).
7. Ant system:optimization by a colony of cooperationg agents. IEEE Transactions on Systems. Man, and Cybernetics-Part B,1996,26(1):29-41. Duan Haibin. (2005). (In Chinese) Eberhart R C, Shi Y. (1998).
8. Comparison between genetic algorithms and Particle Swarm Optimization.Porto V
9. W,Saravanan N,Waagen D, et al.Evolutionary ProgrammingVII Springer,1998:611-616. Eberhart R C, Shi Y. (2000).
10. Comparing inertia weights and constriction factors in Particle Swarm Optimization.Proceedings of the Congress on Evolutionary Computating, 2000: 84-88. Eberhart R, Kennedy J. (1995).
11. 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. Gao Ying, Xie Shengli. (2004).
12. Particle swam optimization Algorithm based on simulated annealing(SA) approach .Computer Engineering and Application, 2004,40(1):47-49. (In Chinese) Higashi N, Iba H. (2003).
13. Particle Swarm Optimization with Gaussian mutation.Proceedings of the 2003 Congress on Evolutionary Computation.Piscataway,NJ:IEEE Press,2003:72-79. Kennedy J, Eberhart R. (1995).
14. Particle Swarm Optimization.Proc of IEEE International Conference on Neural Network,Perth,Australia,IEEE Service Center Piscataway NJ,1995:1942-1948.

