Utilization of Particle Swarm Optimization (PSO) Use as Clustering Algorithm in MANET

Neeraj Kumar Jarouliya[#1], Dr. Nirupama Tiwari[#2]
[#1]*M.Tech. Research Scholar, Computer Science & Engg. Dept SRCEM, BANMORE (M.P.), India*
[#2]*Professor, Computer Science & Engg. Dept, SRCEM, BANMORE (M.P.), India*

Abstract

Mobile ad-hoc networks (MANETs) have been proposed to support dynamic scenarios where no infrastructure exists. Each node in the network acts as a host as well as a router and, forwards traffic to other nodes. MANETs can be set up quickly and at low cost in contrast to infrastructure networks, which may wired or wireless.

In this paper, we propose a Particle Swarm Optimization (PSO) to one clustering algorithm, PSO is initialize with a group of random particles (solutions) and then searches for optima by updating generations. In iterations, each particle has updated by following two "best" values. The first one is the best solution (fitness) it has achieved so far. (The fitness value is also stored.) This value called Pbest. When a particle takes part of the population as its topological neighbors, the best value is a local best and it is called Lbest. After finding the two best values, the particle updates its velocity and positions with mathematical equations. The proposed technique is such that each cluster head handles the maximum possible number of mobile nodes in its cluster in order to facilitate the optimal operation of the MAC protocol.

The individuals (Particles) have divided into groups running in four neighborhood nodes simultaneously, extending the algorithm in a distributed computing manner. Simulation study showed that our approach is efficient and effective, especially when the distribution of mobile nodes is dense.

Keywords:- *PSO, Simulated Annealing, Clustering Algorithm, MANET, NS-2*

I. INTRODUCTION

Ad-Hoc is a Latin word, which means for this", meaning for this special purpose only", by expansion it is a special network for a particular application. A mobile ad-hoc network is collections of mobile nodes, which have communicate over radio range. These networks have an important advantage; they do not require any pre existing infrastructure or central administration. Therefore, mobile ad-hoc networks are suitable for temporary communication links. This flexibility, however, comes at a price: communication is difficult to organize due to frequent topology changes.

MANET's characterized by self-organized, dynamic changes of network topology, limited bandwidth, and instability of link capacity, etc, the reliability of data transmission in the network cannot be guaranteed. In some special application conditions with harsh requirements on PDR and link quality, higher criteria for routing protocol will have been laid out. Routing is the act of moving information from a source to a destination in an internetwork. During this process, at least one intermediate node within the internetwork encountered. This concept is not new to computer science since routing has used in the networks in early 1970's. Nevertheless, this concept has achieved popularity from the mid-1980's.Routing is the process of finding a path from a source to destination among randomly distributed routers the broadcasting is inevitable and a common operation in ad-hoc network. It consists of diffusing a message from a source node to all the nodes in the network. Broadcast can be used diffuse information to the whole network. It also used for route discovery protocols in ad-hoc networks.

Particle Swarm Optimization (PSO) (Kennedy and Eberhart, 1995), which is a population-based global search method, known to suffer from premature convergence prior to discovering the true global minimizes. In this thesis, a novel memory-based method proposed which aims to guide the particles through the information deduced from the external memory contents rather than to re-inject them into the population.

This is done by calculate a coefficient, based on the distance of the current particle to the closest best and closest worst particles in the external memory at each iteration. Later, when updating the velocity component, this coefficient added to the current velocity of the particle with a certain probability. Also, randomized upper bound and lower bound values have been defined for the inertia component. The algorithm starts with the upper bound value of the inertia. At each particle evaluation, the inertia is decrease non-linearly with a small value and when its value reaches the lower bound, the inertia value reset to its upper bound.

The resulting PSO finds the global optima much faster than the original PSO and it have been

shows that it also performs better compared with a recent improvement of PSO, CLSPO namely. A state-of-the-art algorithm, CMA-ES (Covariance Matrix Adaptation Evolutionary Strategy), has been also choosing for comparison purposes. It has been showing by experiments that although the CMA-ES shows a better performance than that of our algorithm, in some cases where the overall topology pointing to the global optimum is missing and the attractor volume of global optimum is small, our algorithm performs better and finds the desired optimum value of the function in lesser evaluation counts. The tests have been conduct on standard benchmark functions as well as a simulation of the Aldebaran NAO robot for developing a kick action.

The particle swarm algorithm is a computational method to optimize a problem iteratively. As the neighborhood determines the sufficiency and frequency of information flow, the static and dynamic neighborhoods discussed. With velocity each particle moves with in the search space and dynamically adjusts its velocity, according to its previous behaviors. Therefore, particles tend to move towards better points within the search space. Since the method is easy to implement and has various application areas, neighborhood topologies used in the particle swarm optimization, parameter adjustment of particle swarm optimization algorithms, hybrid particle swarm optimization algorithms, stability analysis of the particle swarm optimization, and applications of particle swarm optimization method.

II. PROBLEM DOMAIN

Mobile ad-hoc network is one of growing field of research where many works have done; in our paper, which is based on simulated annealing, have following issues:

- Repeatedly annealing with a 1/log k schedule is very slow, especially if the cost function is expensive to compute.
- For problems where the energy landscape is smooth, or there are few local minima, SA is overkill --- simpler, faster methods (e.g., gradient descent) will work better. But generally don't know what the energy landscape is for a particular problem.
- Heuristic methods, which are problem-specific or take advantage of extra information about the system, will often be better than general methods, although SA is often comparable to heuristics
- The method cannot tell whether it has found an optimal solution. Some other complimentary method (e.g. branch and bound) is required to do this.

III. APPLYING PSO

Mobile ad-hoc network is one of the most focusing area of research where lots of work done in this field cluster formation is one the technique by which researchers focus over the easiest communication now for cluster formation we apply particle swarm optimization

Step1: initialize network
Step2: communication start send RREQ packet
Step3: RREQ packet contain hop count information
Step3: generate population of nodes according to their hop count
Step4: set the parameter c1, c2, w1,w2 as constant
Step5: nodes (population) create their neighbor by using fitness function
Step6: if (nodes hop count between two)
Node become neighbor and form cluster
Update velocity and position of nodes by using above mention formula
If (velocity is high){
Node exclude from cluster
And these nodes are free nodes or work for path builder
Else
Node include cluster
Else
Node search best neighbor
Step7: data transfer happen within the cluster using cluster nodes
Step8: data send outside by using outer or boundary node
Step9: update cluster using their velocity
Step9: nodes change its velocity update its position and calculate fitness using hop count and repeat step 3 to 6
Step10: nodes move freely and form cluster whenever they found neighbors or want to send data
Step11: communication takes place
Step12: exit

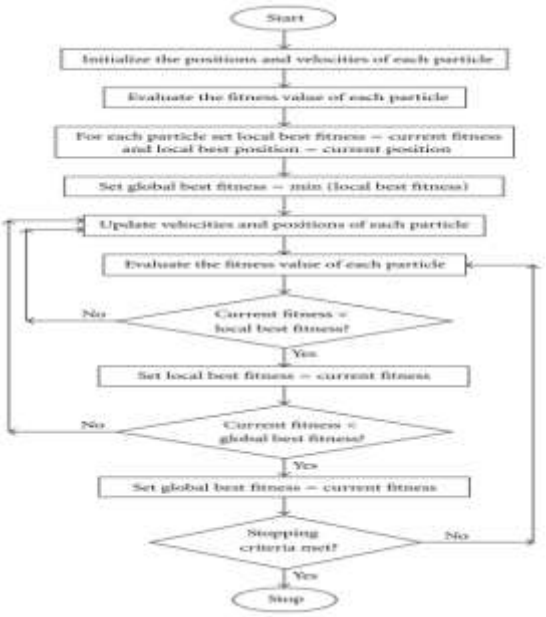

Figure 1: PSO flow chart

IV. RESULT ANALYSIS

Packet Delivery Ratio

The packet delivery ratio (PDR) of a network is defined as the ratio of total number of data packets actually received and total number of data packets transmitted by senders.

$$\textbf{Pdr} = \frac{\sum \textbf{Number of packet receive}}{\sum \textbf{Number of packet send}}$$

Throughput

The average network throughput refers to the amount of the data packets in seconds that are transmit over a communication channel to the final destination node successfully. In this paper throughput is defined as: Throughput = Number of delivered packets * packet size*8 bit / total duration of simulation. It is always measures in data packets/second or data packets/time slot.

End to end delay

The End-to-End delay defined as the difference between two time instances: one when packets generated at the sender and the other, when packet I received by the receiving application.

$$\textbf{End to End Dela} = \frac{\sum (\textbf{arrive time} - \textbf{send time}}{\sum \textbf{Number of connections}}$$

Comparison of Proposed work with base work:

(A) End To End Delay:

In below graph shown that, end to end delay in earlier technique is greater delay on the other hand our proposed work end to end delay is less in attacked condition that is far less than earlier technique.

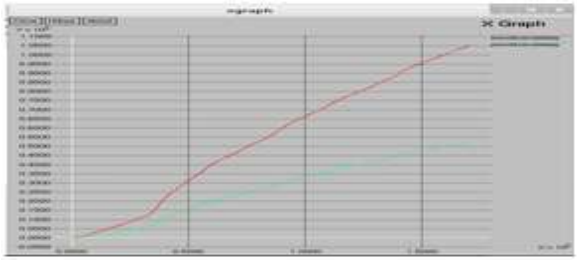

Figure 2: end-to-end delay comparison

In above graph green line indicate proposed work and red line shows earlier technique. so, this comparative graph propose algorithm end to end delay. and it's minimum value is 0.001 ms and highest is 0.046 ms if we compare this value with earlier technique work so minimum value for earlier technique end to end delay is 0.004ms and highest value is 0.146ms so on the basis of these values we conclude that our propose work is a novel solution for this problem.

(B) Packet delivery ratio :

Below graph shows comparison graph of earlier technique and proposed work based on graph we see that our propose work is far better than earlier technique.

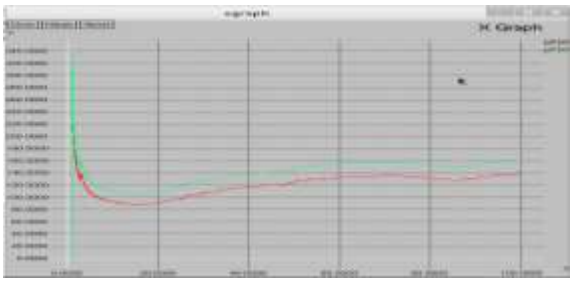

Figure 3: packet delivery comparison

In above graph green line shows proposed work and red line shows earlier technique. so, When the simulation start minimum packet delivery ratio of our proposed technique is 0.90 and highest is 0.98 and the other end earlier technique minimum packet delivery ratio is 0.00 and highest 0.97 so on the basis of these comparative results we easily say that our propose work is an novel approach.

(C) Throughput:

Below graph shown the comparison between earlier technique and our proposed work so on the basis of comparison we easily say that our proposed technique is far better compare to earlier technique.

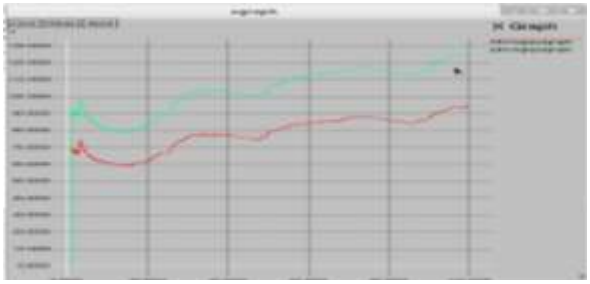

Figure 4: throughput comparison

In above graph green line shows proposed work and red line shows earlier technique. so when simulation starts because of our proposed solution throughput increases gradually and reach highest point as compare to base solution, on the other hand when simulation start in our earlier technique paper throughput increases rapidly and decrease also with same manner it's not good in real time scenario.

V. CONCLUSION

MANET is a dynamic transportation of statement. In this network the mobility and dynamic network topology is an essential property of network. These properties are making it adoptable for different complex applications. The major areas of applications are also ad hoc in nature such as battle fields, disaster management and others. These applications are rapidly configured on ground and become operational in small units of time. On the other hand the performance and security is major area of concern in such network. Therefore various performance enhancement techniques and security techniques are developed in recent years.

In this presented work the ad hoc networks performance and scalability issues are investigated and cluster based solution is presented. In the proposed clustering technique the network node's performance parameters are used as the quality of the nodes and based on the optimum node quality the cluster Head choice is executed. The cluster head choice algorithm usage the weighted system for locating the top-rated node. Because the nodes quality estimation is performed on different scales of performance parameters thus weight calculation normalize all the different scale parameters and makes a single domain result.

Finally the weighted concept of the mobile ad hoc clustering technique is implemented using NS2 simulation environment and the performance of the network is computed. The performance summary according to the experimental evaluation of network is demonstrated using the table 7.1, according to the demonstrated outcomes of the proposed clustering algorithm provides optimum network clusters and able to scale the performance of network successfully.

S. No.	Parameters	Proposed scheme	Traditional scheme
1	Throughput	High	Low
2	Packet delivery ratio	High	Low
3	End to End Delay	High	Low

Table 1: performance summary

VI. FUTURE WORK

The proposed cluster head selection algorithm is designed and implemented successfully and the performance of the proposed technique is compared with the traditional cluster head selection technique. Among them, the performance of the proposed scheme is found optimum as compared to the traditional approach. However, in the proposed technique the performance of the network is lack in terms of throughput. Thus in near future the throughput optimization is performed.

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