Fitness Function Based Particle Swarm Optimization Algorithm for Mobile Adhoc Networks

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Abstract

Mobile adhoc network is a network which carries out discussion between nodes in the absence of infrastructure. The fitness function based Particle Swarm Optimization Algorithm has been projected for improving the network performance. The effect of changing the number of nodes, communication range and transmission range is investigated on various qualities of service metrics namely packet delivery ratio, throughput and average delay. The investigation has been carried out using NS-2 simulator.

Keywords: Mobile Adhoc Network, Particle Swarm Optimization and Routing Protocol.

1. Introduction

Fickleness, Effective conservation of resources, best passage, and power to produce the intended effect are some of the design issues in mobile adhoc network. These issues can be tackled through the swarm intelligence algorithm. Swarm intelligence algorithm includes particle swarm optimization and ant colony optimization. Best results are achieved when such techniques are applied to complex tasks (Ali & Shahzad, 2011). PSO algorithm is simple to execute and extremely proficient in the universal hunting (Priyadharshini & Selvan, 2016). A particular category of mobile adhoc network is Vehicular ad -hoc networks (Harrabia & Ghedira, 2016). One of the routing protocols that are considered in mobile adhoc network is greedy perimeter stateless routing (GPSR). This is a protocol in which it is presumed that every node is aware of the remote location. By transmitting the signal every node tells about its presence to the neighboring node that includes the remote location and node id. GPSR acquisitively sends the packet to target through the nearest hop however there are situations in which there is no nearest hop. In such a situation GPSR attempts to move in the empty region with the help of perimeter nodes. As we know that it is a location based routing protocol in which every transmitting node should be familiar with location of nearest neighbor and target in addition to its own location. It execute better in the networks who are having high density. This protocol may not fit well in case of military applications which necessitate that location information should be kept confidential. Whereas it rely on the geographical information. The requirement for finding the route is also abolished using GPSR (Rowaihy & BinSahaq, 2016). The complexity stage for the choice of the suitable set and amount of nodes and their frequency for trustworthy so far proficient conversation also enhances with the system dimension (Atakan & Akan, 2006). The various categories of bio-inspired provides way out to the difficulties associated with field of communication are bio-inspired calculation, bio-inspired organization and bio-inspired system (Dressler & Akan, 2010).

In addition the paper is arranged in the subsequent way. The related work revealed in the literature is demonstrated in Section II. Section III describes the proposed work. The aspects of simulation environment and metrics employed are explained in section IV and Section V. Section VI describes the results and discussion. At last section VII provide details about the conclusion.

2. Related Work

Various routing protocols have been analyzed in reference to various performance metrics such as load balancing, proactive, reactive behavior, energy aware, multipath, physical implementation etc (Ali & Shahzad, 2011). To minimize the loss and overheads the route of node having less strength is redirected to the route of node with powerful strength (Priyadharshini & Selvan, 2016). The multicast routing which supports particle swarm optimization are quicker as compared to the algorithms which rely on genetic algorithm, while comparing particle swarm optimization and genetic algorithm it is found that PSO results in best multicast tree in smallest possible time as its run time is lesser in comparison to genetic algorithm (Nasab, Derhamia, Khanlib, Bidokia, 2012). To enhance the lifetime of the system the consistent load is allocated on all the paths (Jamali, Rezaei, Gudakhriz, 2013). To minimize the congestion in the network the packets are directed towards the optimization route that needs to be followed to reach the destination (Antoniou, Pitsillides, Blackwell, Engelbrecht, Michael, 2012). PSO is employed in vehicular adhoc network to solve the troubles related to altering system topology and unbalanced path (Harrabia, Jaffar & Ghedira, 2016). Linear and non-linear programming approaches are used for solving issues related to energy efficiency and clustering. The cluster heads are allocated minimum number of nodes so as to enhance the life time of system. By this way
overheads are minimized resulting in the stabilization of the power utilization of cluster heads (Kuila & Jana, 2014). In mobile wireless sensor networks AOMDV does not perform well as it yields larger routing overheads during the process of finding the path. This will result in high power utilization. However greedy perimeter stateless routing employs the geographical information. Through this the requirement for path finding is abolished which was required in case of AOMDV (Rowaily & BinSahaq, 2016). PSO Algorithm uses managed nodes referred to as agents for getting advancement in connectivity of mobile adhoc network thereby enhancing the execution of mobile adhoc network (Dengiz, Konak & Smith, 2011). An algorithm HPSOGWO has been projected in (Singh & Singh, 2017) in which PSO and Grey Wolf Optimizer (GWO) has been hybridized to recover the capacity of utilization in PSO with the capacity of investigation in GWO to create variants strength.

3. Proposed Work

In this paper fitness function based Particle Swarm Optimization Algorithm has been proposed. To check the effectiveness of the proposed algorithm the algorithm is tested with 50 nodes which however can be varied to any other value. Particle swarm optimization (PSO) rely on the bird flocking for solving the problems related to optimization and optimized solutions are maintained by every particle. These solutions are distributed between them. Further PSO is efficiently capable of cracking the multi objective optimization tasks. PSO reduces the power utilization of the system to improve the node life time that will guarantee the routing which is power efficient.

Design of PSO Algorithm:
- Every series of route is treated as particle. Primary position and velocity are assigned to every particle. Every particle has own finest position and there is position which is finest among all the particles.
- To determine how fine is position of \(i^{th}\) particle with respect to preferred objective is calculated using function \(F(X_i)\).
- Then \(P_{best}\) and \(G_{best}\) are calculated.
- The velocity is calculated by the difference of \(G_{best}\) and \(P_{best}\).
- At last the positions are updated and packets are dispatched through route in which node which has minimum cost.

4. Simulation Environment

Simulation has been carried out using ns-2 with the use of topology which has been defined in figure. The numbers of nodes that will carry out the conversation are taken 50. Traffic type is Constant Bit Rate (CBR) and packet size kept was equal to 512 Byte. Propagation employed while carrying out the simulation is Two Ray Ground. Simulation will start at 250 sec. The topology dimension i.e array taken is 1000×1000. Full duplex communication will be constructed between the nodes.

| Parameter | Value |
|-----------|-------|
| Simulator | NS-2  |
| Protocols studied | GPSR |
| Simulation area | 1000×1000 |
| Transmission range | 100m, 250 m |
| Node movement model | Random waypoint |
| Traffic type | CBR |
| Simulation time | 250 Seconds |
| Data payload | 1460 Bytes / packet |

5. Metrics Employed

To check the efficiency of the planned algorithm the various parameters have been assessed.

Throughput: It is the quantity of digital information per unit time sent via a connection which can be physical or logical. It is computed in bits/second.

\[
\text{Throughput} = \frac{\text{Number of packets sent productively}}{\text{Total Period}}
\]

Packet delivery ratio (PDR): It is evaluation of one hundredth of packets sent productively to the destination node.

\[
\text{Delivery Ratio} = \frac{(\text{Number of packets dispatched} - \text{damaged packets}) \times 100}{\text{Number of packets dispatched}}
\]

End-to-End delay: Although it refers to the transfer of information from transmitting node to the target node over a given period of time. But it rarely happens that transfer of packets take place among two adjoining nodes rather it consist of various intermediate nodes. Thus end-to-end delay is the addition of delays encountered at every hop from transmitting to target.

\[
\text{End-to-End delay} = \frac{\text{Time utilized on hop1} + \text{time utilized on hop2} + \ldots + \text{time utilized on hop n}}{\text{Number of packets dispatched}}
\]

6. Results and Discussion

For investigating the execution of the work network simulator NS2 having version 2.35 is used. 50 nodes are positioned arbitrarily in an area of 1000×1000 square meters. The Variation of Communication Range Vs Packet delivery ratio is shown in Figure 1. From the graph it has been verified that packet delivery ratio increases with the communication range as it is increased from 50 meters to 550 meters.

Figure 2 shows how the Transmission Range varies with Packet delivery ratio. From the graph it has been verified that packet delivery ratio increases with the Transmission range as it is increased from 100 meters to 250 meters.

![Communication Range Vs Packet delivery ratio](image1)

![Transmission Range Vs Packet Delivery Ratio](image2)
Transmission range with respect to throughput is shown in Figure 4. It has been observed that digital information sent via physical or logical connection increases as transmission range is increased from 100 to 250 meters.

![Figure 4: Transmission Range Vs Throughput](image)

Transmission range with respect to Average delay is shown in Figure 6. Its value decreases in the graph as we increase the transmission range from 100 to 250 meters.

![Figure 6: Transmission Range Vs Average Delay](image)

**7. Conclusion**

The proposed technique has been executed and discussed in terms of several performance metrics. The performance metrics that have been investigated are throughput, packet delivery ratio and end-to-end delay. Throughput increases with the increase of communication and transmission range. PDR also enhances with the increase of communication and transmission range. However average delay decreases with the enhancement of transmission and communication range.

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