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Energy efficient DSDV Protocol with PSO route optimization

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***Abstract*— The hotspot problem which lacks the performance of WSN is the Energy Constraint. Due to this limitation, the lifetime of the Network also suffers. To increase the network lifetime of WSN, the two well known optimization problem i.e. energy efficient clustering and routing is continuously widely researched and studies. In this paper, we proposed a protocol based on Efficient Destination Sequenced Distance Vector routing with Particle Swarm Optimization technique. The proposed algorithm is experimented extensively and results are compared with the existing algorithm: EPSO-CEO to demonstrate its superiority in terms of energy optimization, PDR, Average delay thus by improving the performance metrics, the proposed protocol efficiently enhance the lifetime of network.**

***Keywords*— Wireless Sensor Network, DSDV, PSO, EPSO-CEO, Cluster head, Energy efficient.**

I. INTRODUCTION

Wireless sensor network are made up of small, low powered and multi functional nodes, by many years of researches, these nodes are capable of performing multiple complex task[1]. Wireless sensor nodes performs sensing, aggregation and processing of data. WSN consist of many units, one of them is power used. Power unit contains battery which serve the power to the whole network.

Energy consumption is one of the foremost problem, which limits the execution of the network. In the accomplishment of transmission, reception or idle listening or overhearing, it may get minimized. One of the solution to overcome this problem is the formation of routes for transmitting data packets as short routes containing nodes with exhausted batteries may leads to poor lifetime of network whereas on the other end long routes can raise the network delay because the route contains huge number of nodes. Choosing a short route may leads to depletion of intermediate nodes which results into decrease in lifetime of the network, but at the same time shortest route might contribute good results in terms of low energy consumption and enhanced lifetime of network [2].

A. Blending of PSO technique with any other intelligent technique:

To introduce any intelligent approach in PSO technique are adapted to regulate more advanced optimized swarm. Thus the advanced hybrid PSO approach has better selection of particles and better selected particles are reproduced into next generation in order of proper and better functioning of PSO. Therefore we are blending PSO with DSDV protocol in this paper for better enhancement of lifetime of network.

B. Protocols used for implementation:

In this paper, we are using two protocols which as follow:

1) DSDV Routing Protocol:

It is also known as Table Driven routing protocol. It is based on classical Bellman-Ford algorithm. At the start every node in the network interchanges its own route tables to its neighbor node. If there is any change in routing table then according to those changes neighbouring node update their routing table. For updating the routing table they use two type of packets- Full Dump Packet and Incremental Packet. Full Dump Packet keeps the track of information about every node in the network. These packets are transmitted periodically. Incremental Packet keeps update regarding the changes in node position of Full Dump Packet. Full Dump Packets also transmitted periodically and that stored in additional table. According to current entry in table routes are selected. DSDV is good for networks where nodes are less dynamic. There is wastage of bandwidth if the position of nodes changes in short interval of time because then it required more number of full dump packet. The DSDV protocol requires representing the position of current neighbouring node itself in routing table. The entries in the routing table change regularly so each node in the network need to advertise the change in updating of routing table to the neighbouring node. Also when there is request from

other node so it is responsibility of that node to providing updated routing information. For obtaining a rout to a destination, the shortest number of hops is determined by this algorithm. If some time there is no need of any host node in the network and it is in sleep mode then protocol does not disturb it unnecessarily. In this way even if the destination node not within the range of communication, a mobile node exchange data with any other mobile node in the group. If the notifications of other mobile node are done at layer 2 by any particular node then DSDV will work with whatever higher layer[3].

2) *Particle Swarm Optimization:*

Particle swarm optimization is an approach of heuristic global optimization which is introduced by Doctor Kennedy and Eberhart in the year 1995. It is appeared from swarm intelligence technique and which is based on the natural phenomenon of bird flocking and fish schooling. During the time of searching of food, the birds are either go alone or go together before they find the place where they get the food. When the birds are roaming for food from one location to another location, there is a bird always that can perceive the smell of food very well, that is, the bird is able to detect the place where the food can be found, having the better food service data. Because they are transmitting the information, in the mean time searching the food from one place to another and the information is efficient for other birds because having the good information, the birds will finally flock to the place where food can be found. The competence swam is compared to the bird swarm, the birds' movement from one location to another location is typically equal to the development of the solution swarm With respect to particle swam optimization method, good information is equal to the most hopeful solution, and the food location is equal to the most hopeful solution during the complete span. The most hopeful solution can be carried out in particle swarm optimization algorithm by the coordination of every particle. The individual without quality and volume performs as every single individual, and the simple behavioral structure is carried out for each individual to display the complication of the complete particle swarm. This algorithm is used to carried out the complicated hopeful problems[4]. The location of each "i" particle in the swarm is affected by both the position of the most optimist particle in its surrounding and the most optimist position during its movement. When the whole particle swarm is encircling the particle, the most optimist position of the encircling is equal to the one of the whole most optimist particle; this algorithm is called the algorithm PSO. The algorithm will be called as the partial PSO if the narrow surrounding is used in it. Each particle can be visible by its current speed and position, the most optimist position of each individual and the most hopeful position of the encircled area. In the partial PSO, the speed and position of each particle change according to the particle velocity.

Each particle keep an eye on the coordinates in the problem space which are comrade with the best solution i.e. fitness. This obtained term is known as pbest.

Another "best" value that is routed by the optimizer of particle swarm is the best value, obtained in the neighbours of the particle by any particle. This location is called lbest where l in term is the location. When a particle takes all the population as its topological neighbours, the best value is a global best and this value obtained known as gbest where g is the global in the term. The particle swarm optimization method be formed of, at very single time pace, transmuting the velocity of every single particle approaching its pbest and lbest locations [5].

C. Network Simulator:

Simulation can be defined as an approach of reproducing all the scenarios of a system, which is not feasible to develop, run and test on the real grounds initially, with the help of software before its actual development and deployment.

The simulator NS-2 provides simulation environment having greater flexibility in exploring the attributes of sensor networks because it already contains versatile models for energy limitation problem of wireless ad hoc networks. In this environment a sensor network can be constructed with many of the same set of protocols and attributes same as those available in the real world. NS-2 includes support for each of the paradigms and protocols for the mobile networking environment. The wireless model also comprises brace for node motion and energy limitation problem.

NS-2 has many and expanding uses including:

- To analyse the performance of existing network protocols.
- To analyse new network protocols before use.
- To run large scale experiments which are not possible in real experiments.
- To simulate a variety of Internet Protocol networks [6].

II. Related Work

Shankar et al. [7] explored a propounded algorithm exhibits high search coherence of HSA and dynamic concord of PSO that improves the lifetime of sensor nodes. The implementation of the hybrid algorithm is assessed using the number of alive nodes, throughput and residual energy ,number of dead nodes. The proposed hybrid HSA-PSO algorithm shows an enhancement in leftover energy and throughput by 83.89% and 29.00%, respectively, than the PSO algorithm.

Shefali et al. [2] focuses on the perspective and profound a nature inspired approach to acquire a route of high energy for addressing data to the destination in order to reduce the energy consumption and raise the network lifetime. The simulation results achieved on MATLAB and concludes that the propounded technique consumes minimum energy in comparison to the existing route finding algorithms.

Vimalarani et al.[8] analyzed an Enhanced PSO-Based Clustering Energy Optimization (EPSO-CEO) algorithm for WSN in which clustering and clustering head preferences are done by using Particle Swarm Optimization (PSO) algorithm with respect to minimizing the power utilization in WSN. The performance metrics are computed and results are compared with competitive clustering algorithm to validate the decrease in energy consumption.

Lee et al. [9] presented mathematical models for a routing protocol (network design) under particular resource constraint within a wireless sensor network. We consider two types of constraints: the distance between the energy used by the sensors and the linking sensors . The propounded models aim to identify energy-efficient paths that minimize the energy utilization of the network from the source sensor to the base station. The computational results show that the presented models can be used effectively and applied to other network design contexts with resource restrictions.

Bahi et al. [10] introduced an efficient lifetime optimization and self-stabilizing algorithm to improve the lifetime of wireless sensor networks especially when the reliabilities of sensor nodes are expected to fall down due to use and wear-out effects. Our algorithm seeks to build resiliency by maintaining a necessary set of working nodes and substituting failed ones when needed.

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Rahman et al. [11] focuses on finding the optimal sink position. Relay nodes are institute in conjunction with the sensor nodes to mitigate network geometric deficiencies since in most other ways the sensor nodes close to the sink become heavily involved in data forwarding and, thus, their batteries are quickly exhausted. A Particle Swarm Optimization (PSO) based algorithm is used to locate the optimal sink location with respect to those retail nodes to make the network more energy effective. The relay nodes communicate with the sink rather than the sensor nodes. Tests show that this approach can save at least 40% of the energy and prolong the network lifetime.

III. Problem formulation and proposed work

A. *Problem formulation:*

WSN become very popular in communication but it is suffering from a critical problem of energy optimization. Sensor nodes are deployed in abandoned areas in general that make the power source of the sensors difficult to recharge. Consequently, much research effort has focused on maximizing the lifetime of the WSN.

B. *Proposed Work:*

In this paper, a new and improvised protocol has been developed that employs two different routing protocol i.e. DSDV and PSO for energy optimization in wireless sensor network. The proposed protocol out forms the existing protocol in terms of energy optimization, average delay, packet delivery ratio.

IV. Simulation Parameters

TABLE I
Simulation Parameters used

S. No.	Simulation Parameters	
	Parameter Used	**Value**
1.	Channel type	Wireless channel
2.	Number of nodes	50
3.	Area (deployment)	1200*1200 Sqm
4.	Initial energy	3 joules.
5.	MAC type	802.11
6.	Antenna model	Omni Direction Antenna
7.	Propagation model	free space/two-ray ground
8.	Transmission power	0.02 watts
9.	Receiving power	0.01watts
10.	Queue type	Priority queue
11.	Simulation time	200 seconds

V. Results and analysis

Result and its analysis based on the simulation performed in NS-2.34 simulator. To compare the performance of proposed protocol with EPSO-CEO, consider the performance metrics of total energy consumed, total packet drop, delay, throughput, packet delivery ratio.

A. *Total Energy Consumed:* The total amount of energy consumed by the nodes to transmitting the packets through the simulation in joules and the comparison between the proposed protocol with EPSO-CEO protocol is given below:

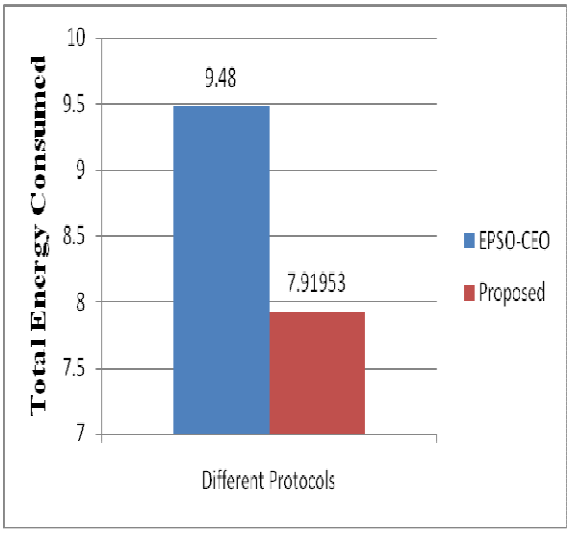

Fig.1 Comparison of Total Energy Consumed by Proposed protocol with EPSO-CEO.

B. *Average Delay:* The average time taken to route a data packet from source node to target node. It is computed in seconds and the comparison between the proposed protocol with EPSO-CEO protocol is given below:

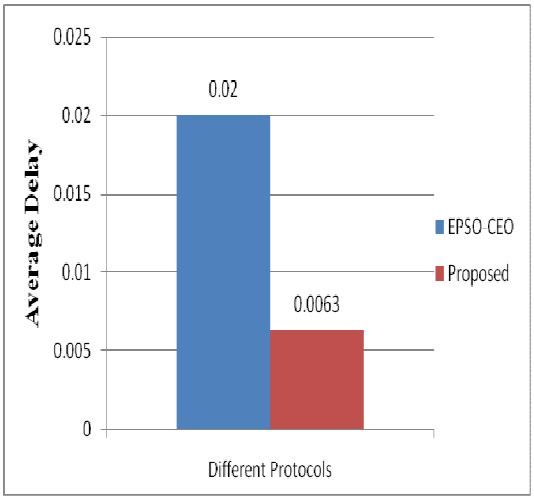

Fig.2 Comparison of Average Delay in Proposed protocol with EPSO-CEO.

C. *Packet Delivery Ratio Percent:* The number of packets successfully received with respect to the total number of packets transmitted and the comparison between the proposed protocol with EPSO-CEO protocol is given below:

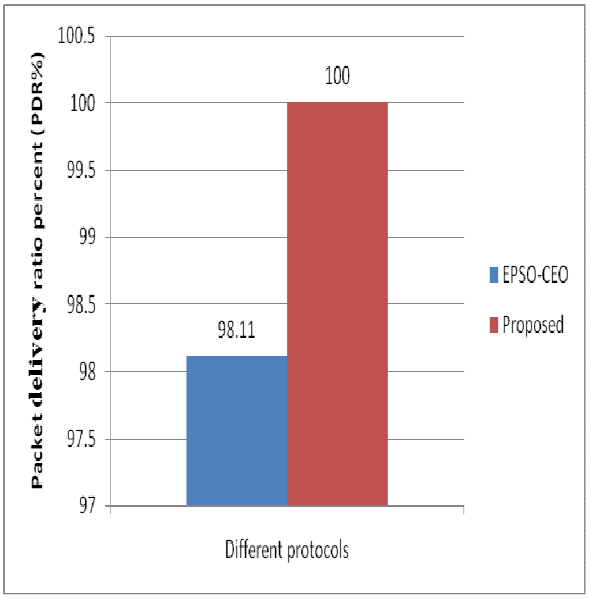

Fig.3 Comparison of Packet delivery ratio percent in Proposed protocol with EPSO-CEO.

D. *Average Throughput:*
The measure of ratio of number of packets transmitted by number of nodes per second is the Throughput and the comparison between the proposed protocol with EPSO-CEO protocol is given below:

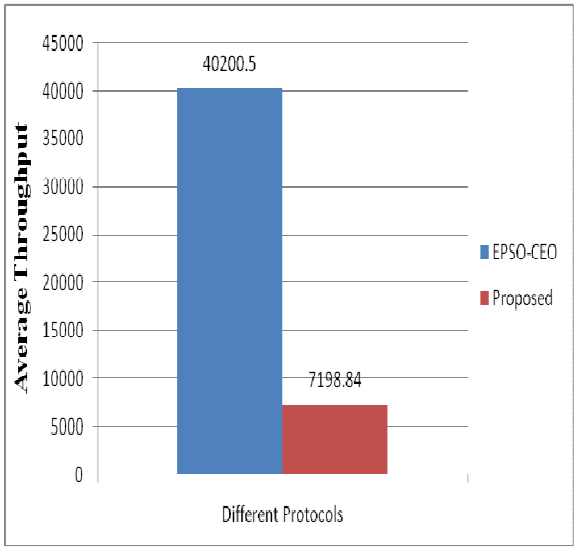

Fig.4 Comparison of Average Throughput in Proposed protocol with EPSO-CEO.

VI. PERFORMANCE COMPARISON OF PROPOSED PROTOCOL WITH EPSO-CEO AND EXISTING PROTOCOL:

TABLE 2
COMPARISON TABLE OF PERFORMANCE METRICS OF PROPOSED METRICS WITH EPSO-CEO METRICS.

S. No.	Comparison of Performance Metrics		
	Performance Metrics	**EPSO-CEO**	**Proposed Protocol**
1.	Total Energy Consumed (joules)	9.48	7.91953
2.	Total Packet sent	1584	1168
3.	Total Packet received	1554	1168
4.	Total Packet dropped	30	0
5.	Packet delivery ratio percent (PDR%)	98.11	100
6.	Average Delay (s)	0.02	0.0063
7.	Average Throughput (b/s)	40200.5	7198.84

After the comparative results, several points about the proposed model to be discussed are as follows:

1. The consumption of the total energy and the server energy is much lesser than the EPSO-CEO protocol.
2. The Most advancing achievement of this paper is that the PDR is 100%
3. Average delay is much lesser than the existing protocol.

VII. CONCLUSIONS

The Performance of Wireless Sensor Network is enhanced bye the proposed Algorithm based on DSDV with PSO protocol in terms of increased Packet delivery ratio, decreasing the average delay and total energy consumption during execution. The Proposed Algorithm firstly calculates the route and then the route is optimized. The performance metrics such as PDR, average delay, total energy consumption, average throughput are evaluated and compared with the competitive EPSO-CEO technique. The simulation outcome shows that this proposed scheme in the paper provides improved performance in order to enhance the lifetime of the wireless sensor network. In future, the work can be extending to improve the lifetime of network by improving the performance metric Throughput in certain level in the proposed system.

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