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Energy Efficient Optimal Paths Using PDORP-LC

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Abstract: **Energy consumption is one of the constraints in Wireless Sensor Networks (WSNs). The routing protocols are the hot areas to address quality-of-service (QoS) related issues viz. Energy consumption, network lifetime, network scalability and packet overhead. In existing system a hybrid optimization based PEGASIS-DSR optimized routing protocol (PDORP) is presented which used cache and directional transmission concept of both proactive and reactive routing protocols. The performance of PDORP has been evaluated and the results indicated that it performs better in most significant parameters. The performance of the existing method is checked when it is evaluated and validated with the nodes which are highly dynamic in nature based on the application requirement. The current system finds the trusted nodes in the case of only static environment. To overcome the issue the proposed system is applied for dynamic WSN's with the location frequently being changed. The PDORP-LC is applied with local caching (LC) to acquire the location information so that the path learning can be dynamic without depending on the fixed location. The proposed work is performing in dynamic environment with the dynamic derivation of trusted nodes.**

Keywords: **local caching (LC), Wireless Sensor Networks (WSNs), PEGASIS-DSR optimized routing protocol (PDORP).**

1. INTRODUCTION

In Wireless sensor networks (WSNs), the main source of lifetime for the hubs is the battery. Communicating with different hubs or sensing activities expends a great amount of energy in preparing the information and transmitting the gathered information to the sink. As several cases, it is undesirable to supplant the batteries that are draining or depleted of energy. Numerous scientists are in this field attempting to discover power-aware protocols for wireless sensor networks, keeping in mind the end goal to overcome such energy effectiveness issues but they have their own assumptions. For the optimization of WSN designs, researchers have proposed various approaches. To meet different design criteria, related researches into the optimization of wireless sensor network design can be grouped into three categories: 1) Optimization in the communication layers; 2) Node hardware optimization and 3) Cross-layer optimization. However, most of the optimization procedures do not take into account the principles, characteristics and requirements of WSN which is application defined. In existing approach energy optimization is done using hybrid algorithms i.e. GA and BFO method in DSR protocol. Within the application layer, the traffic load is usually squeezed to scale back the data size. Various algorithms such as in-network data processing is actually produced to scale back energy consumption when compared to transmitting the raw data towards end node. The routing layer as well as MAC layer is usually optimized by simply choosing appropriate. Protocols to gain productivity. Node optimization can be achieved by simply strengthening battery utilization as well as implementing power-aware equipment layout. Three different types of optimizations are labeled: optimization of the communication layers; the actual node optimization; as well as cross-layer optimization. By using the dynamic WSN's with the location frequently being changed. PDORP-LC is applied with local caching (LC) to acquire the location information so that the path learning can be dynamic without depending on the fixed location

2. RELATED WORK

2.1 A Genetic Algorithm for Shortest Path Routing Problem and the Sizing of Populations:

This paper presents a genetic algorithmic approach to the shortest path (SP) routing problem. Variable-length chromosomes (strings) and their genes (parameters) have been used for encoding the problem. The crossover operation exchanges partial chromosomes (partial routes) at positionally independent crossing sites and the mutation operation maintains the genetic diversity of the population. The proposed algorithm can cure all the infeasible chromosomes with a simple repair function. Crossover and mutation together provide a search capability that results in improved quality of solution and enhanced rate of convergence. This paper also develops a population-sizing equation that facilitates a solution with desired quality. It is based on the gambler's ruin model; the equation has been further enhanced and generalized, however. The equation relates the size of the population, the quality of solution, the cardinality of the alphabet, and other parameters of the proposed algorithm. Computer simulations show that the proposed algorithm exhibits a much better quality of solution (route optimality) and a much higher rate of convergence than other algorithms. The results are relatively independent of problem types (network sizes and topologies) for almost all source–destination pairs. Furthermore, simulation studies emphasize the usefulness of the population-sizing equation. The equation scales to larger networks. It is felt that it can be used for determining an adequate population size (for a desired quality of solution) in the SP routing problem. Index Terms—Gambler's ruin model, genetic algorithms, population size, shortest path routing problem.

2.2 Genetic algorithm based schedulers for grid computing systems:

In this paper we present Genetic Algorithms (GAs) based schedulers for ef- ficiently allocating jobs to resources in a Grid system. Scheduling is a key problem in emergent computational systems, such as Grid and P2P, in order to benefit from the large computing capacity of such systems. We present an extensive study on the usefulness of GAs for designing efficient Grid schedulers when makespan and flowtime are minimized. Two encoding schemes has been considered and most of GA operators for each of them are implemented and empirically studied. The extensive experimental study showed that our GA-based schedulers outperform existing GA implementations in the literature for the problem and also revealed their efficiency when makespan and flowtime are minimized either in a hierarchical or a simultaneous optimization mode; previous approaches considered only the minimization of the makespan. Moreover, we were able to identify which GAs versions work best under certain Grid characteristics, which is very useful for real Grids. Our GA-based schedulers are very fast and hence they can be used to dynamically schedule jobs arrived in the Grid system by running in batch mode for a short time. Keywords: Computational Grids, Scheduling, Genetic Algorithms, Resource Allocation, Make span, Flow time, Expected Time to Compute, Benchmark Simulation Model.

2.3 Optimal PID Governor Tuning of Hydraulic Turbine Generators With Bacterial Foraging Particle Swarm Optimization Algorithm:

To improve the quality of PID parameters of the turbine governor, bacterial foraging optimization (BFO) algorithm was introduced. Considering the slow convergence of BFO algorithm and the good convergence of particle swarm optimization (PSO) algorithm, a novel method named BFO- PSO algorithm was proposed. The integrated ITAE index plus the Jcc index which weights the interaction between bacterial cells constitutes a new type of fitness function, which can reflect the effect of bacterial swarm's mutual attraction, mutual repellence and mutual learning. Through numerical experiments, it's found that compared to the classic BFO algorithm and the classic PSO algorithm, BFO-PSO algorithm converges faster and can effectively improve the dynamic performance of the hydraulic turbine governing system transients on no-load and isolated operation conditions.

2.4. Power Efficient gathering in sensor information systems:

Sensor webs consisting of nodes with limited battery power and wireless communications are deployed to collect useful information from the field. Gathering sensed information in an energy efficient manner is critical to operate the sensor network for a long period of time. In [3] a data collection problem is defined where, in a round of communication, each sensor node has a packet to be sent to the distant base station. If each node transmits its sensed data directly to the base station then it will deplete its power quickly. The LEACH protocol presented in [3] is an elegant solution where clusters are formed to fuse data before transmitting to the base station. By randomizing the cluster heads chosen to transmit to the base station, LEACH achieves a factor of 8 improvement compared to direct transmissions, as measured in terms of when nodes die. In this paper, we propose PEGASIS (Power-Efficient GAthering in Sensor Information Systems), a near optimal chain-based protocol that is an improvement over LEACH. In PEGASIS, each node communicates only with a close neighbor and takes turns transmitting to the base station, thus reducing the amount of energy spent per round. Simulation results show that PEGASIS performs better than LEACH by about 100 to 300% when 1%, 20%, 50% , and 100% of nodes die for different network sizes and topologies.

2.5 Energy efficient chain based cooperative routing protocol for WSN:

Here the purpose is to investigate the reduction in total transmission time and the energy consumption of wireless sensor networks using multi-hop data aggregation by forming coordination in hierarchical clustering. Novel algorithm handles wireless sensor network in numerous circumstances as in large extent and high density deployments. One of the major purposes is to collect information from inaccessible areas by using factorization of the area into subareas (clusters) and appointing cluster head in each of the subarea. Coordination and cooperation among the local nodes via relay nodes in local cluster (By forming sub clusters) helped to serve each and every node. Routing is based on the predefined path, proposed by new transmission algorithm. Transmission distance is minimized by using cluster coordinators for inter cluster communication and relay nodes within the cluster. We show by extended simulations that Chain Based Cluster Cooperative Protocol (CBCCP) performs very well in terms of energy and time. To prove it, we compare it with LEACH, SEP, genetic HCR and ERP and found that new protocol consumes six times less energy than LEACH, five times less energy than SEP, four time less energy than genetic HCR and three times less energy than ERP, which further validate our work.

3. SYSTEM MODEL

A network with limited number of sensor nodes, which are randomly deployed on a 2 - dimension area. All the nodes are homogeneous and they have initial energy ei, where ei > 0. All the nodes have one hop communication and hence they use short range radio transmission. Transmission between two nodes is possible only when the remaining energy of nodes is greater or equal to the threshold level of the energy. We have used the path loss model described in, which is most popular for theoretical analysis and network simulations. We have used the same equation as used in for computation of power reception by the distant node for distance of dist meters. Some other assumptions about the model which are as follows:

- Transmission power of node is adjusted by the node themselves and received signal strength (RSS) can be computed easily.
- Transmission and reception of packets are accomplished with the help of directional antennas.
- Nodes are naïve about their location.
- Nodes have the knowledge of their neighbors to transmit and receive the packets.
- Every sensor node is aware of the direction as per reference to local north.

3.1 Comparison based on various parameters with varying number of sensor nodes:

3.1.1 End to End Transmission Delay: This parameter signifies the total amount of time taken by a packet from source to destination including transmission delay, queuing delay, propagation delay and processing delay. However an increase in the numbers of nodes also increases the difference of delay. The delay in transmission of a data packet is the amount of time between sending data packet by source node and receipt of same at the destination node demonstrates the results for end-to-end delay with varying number of sensor nodes. It has been observed that end to end delay for OD-PRRP increases with increase in the number of nodes. In addition, results show that proposed routing protocol PDORP-LC marginally outperforms than PDORP while considering low packet delivery in dynamic environment.

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3.1.2 Bit Error Rate: The metric defines the measure of the number of errors found in the network during packets sending. It has been seen that value of error rates has been enhanced in the attack clearly shows that DSR protocol has a less error rate as compared to the entire candidate routing protocols. Moreover the proposed algorithm PDORP-LC performs better than PDORP and sometimes from LEACH as well. When a node becomes more aggressive at the time of transfer and previously it was not in the cache memory, the other node is bound to receive a packet from it and in such a way it can cause damage to existing routes. So the proposed solution creates trusties for the first time in each round on the basis of the parameters allocated to the nodes which results in less chance of attack and less bit error rate even in the state of dynamic WSN nodes.

3.1.3 Energy Consumption: This generates lowering of the number of transmissions for the forwarded messages to all the group members. It is defined as the sum of units required for the key transmission throughout the duration of the simulation. The energy consumption formula for transmitting the data is:

$ETx\ (k, d) = Eelec * k + Camp * k * d2, d > 1$

Energy consumption formula of receiving data:

$ERx\ (k) = Eelec * k$

Where k is the data volume to be transmitted, d is the distance among the two sensors. $Eelec$ is the energy consumption to take out the data transmission in terms of n_J/bit. Therefore, the total energy consumed =$\Sigma\ ERx + \Sigma\ ETx$, i.e. the total consumed energy of data receiving + total consumed energy of data transmitting. From the below It has been observed that PRP and new routing protocol PDORP outperforms than DSR, LEECH and OD-PRRP. The energy consumption of proposed algorithm is almost stable even with increase in number of nodes. In terms of energy consumption parameter PDORP will act as optimal routing protocol.

3.1.4 Throughput: This metric describes the average rate of successful messages delivered over the network in a given time. LEACH protocol is better than all other candidate algorithms. DSR is also better than PRP, PDORP and OD-PRRP protocols. It is clearly indicated by the results that LEACH outperforms in throughput oriented applications. The performance of PRP, PORP and OD-PRRP is almost similar in case of throughput.

3.2 Comparison based on various parameters with varying number of rounds:

It has been observed that proposed method outperforms than OD-PRRP, LEACH, DSR, PEGASIS and PDORP-LC while considering bit error rate, end to end transmission delay and energy consumption metrics with varying number of nodes. In case of throughput metric LEACH is better than all other candidate routing protocols, on the other hand LEACH is unsuitable for the applications where energy consumption is a key constraint. . The energy consumption of proposed algorithm is almost stable even with the increase in number of rounds and nodes are in highly dynamic location in nature. In terms of energy consumption parameter PDORP-LC will act as optimal routing protocol. In addition, results show that proposed routing protocol PDORP-LC marginally outperforms than LEACH, DSR, and PEGASIS and even from OD-PRRP while considering low packet delivery delay.

4. PROPOSED WORK

4.1. Introduction:

In this work hybrid optimization based PEGASIS-DSR optimized routing protocol (PDORP) which has used cache and directional transmission concept of both proactive and reactive routing protocols is also compared with the proposed PDORP-LC. The simulation results of our proposed protocol show reduction in end to end transmission delay and bit error rate without compromising with energy efficiency even in the dynamic environment. In PDORP-LC, both the proactive routing and reactive routing methodology along with location caching is used in order to obtain fast and non-damaged path along with lower transmission delay with respective of each location.

4.2. System design:

In this section we discuss the network modeling and the proposed routing model PDORP-LC in detail. By using step A, (Network creation) we have created a network with randomly deployed nodes N (500). The nodes are kept in random position where the position of WSN nodes are changed within the given area at different time intervals, so that the location of nodes will be highly dynamic in nature. We have taken the area of 1000 square meters within the area the nodes are allowed to move freely based on time bound manner in the simulation process.

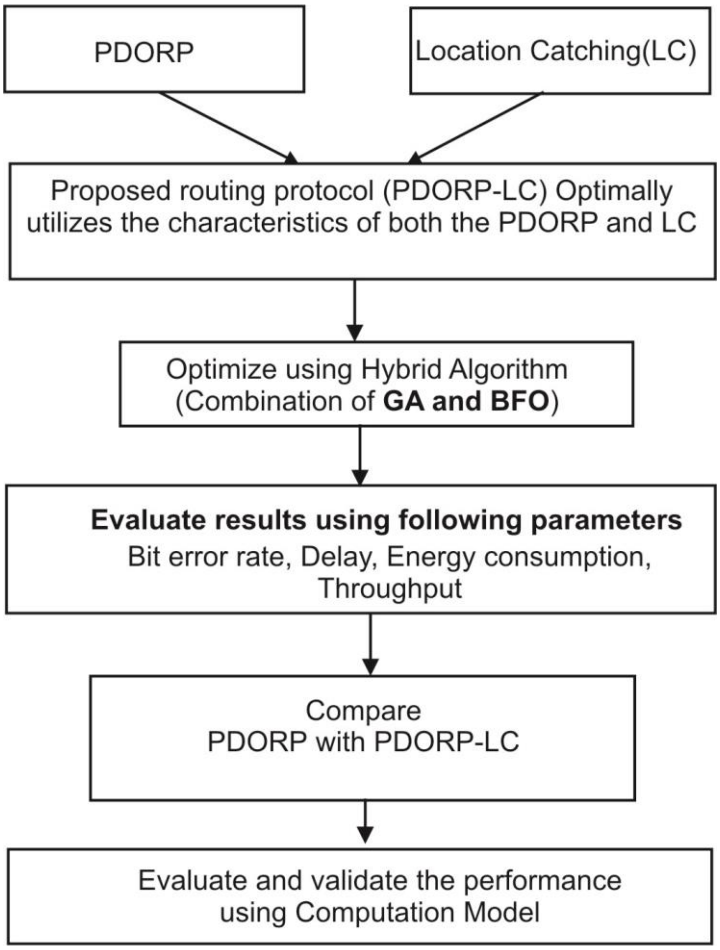

Fig1. System Model of Proposed LC

In the fourth step we have computed the distance ***d*** of all the nodes from their neighbors and we have compared their distance with the threshold ***th*** value of distance, so that they could be connected only when their distance is less than or equals to the threshold value. We have used this algorithm to make it sure that all the nodes are connected with a minimum distant value.

A. Network creation

Network. height=1000

Network.Width=1000;

N=Total_Nodes

Time Bound = 1 Hour to 5 Hours

To overcome the issue the proposed system is applied for dynamic WSN's with the location frequently being changed with the lower bound time of 1 Hour to upper bound time of 5 Hours. The PDORP-LC is applied with local caching (LC) to acquire the location information so that the path learning can be dynamic without depending on the fixed location. The LC learns the local view points of the each WSN nodes from its neighbors whereas all WSN nodes in the system design are inter related and the distance from the G-Router are indexed. The G-Router is a server which collects information from the WSN nodes.

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5. ALGORITHM

LC-Pathfinding

For i=1 :Network.Simulation.Rounds

Source=Initialize.Source;

Source.Id=Node.name(source); Path=[ ]; Pathelement =2; Path[1]=Source;

Source.Packet.count=1000;

LoC_Mark[1]=d[1]+nd;

IndexD[];

Destination.Id=Node.name(Destination);

Current_cov_set_source=cov_set(source.Id,:) dest_found=0; possible_nodes=[ ];

While(dest_found!=1)

If(periodic_update)

For each all n in current_cov_set

If(x(all n)>xloc(Source.Id) && (x(all n)-xloc(Destination.Id) < 0

Possible_nodes[possiblenoedcount] = all n;

Possiblenodecount+=1;

LoC_Mark[all n] = index[n] +nd

Endif

Selection=possiblenodecount*Random;

Selected_node=Possible_nodes[selection];

Possible_Nodes=[ ]; Path(Path element) =selected_Node

Endfor

Endif

6. EXPERIMENTAL EVALUATION

The experimental evaluation is done to prove the efficiency of the proposed system is equal even the nodes or in highly dynamic in nature. The new method is compared with the existing method in Delay, Energy consumption and Throughput parameter.

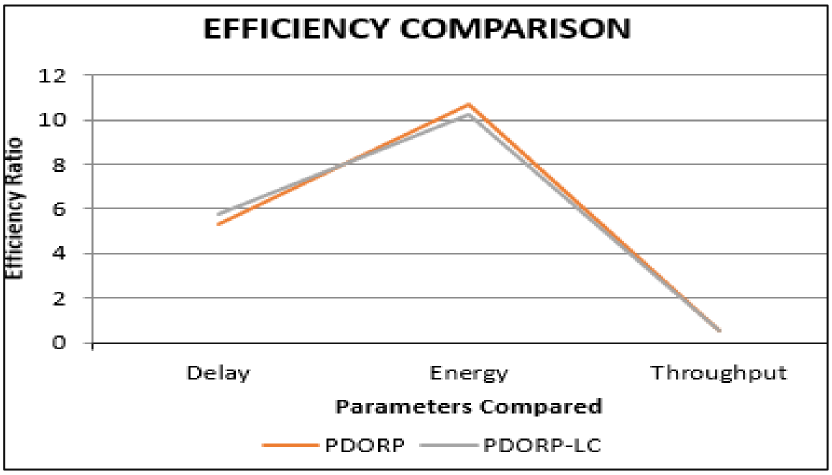

Fig 2. Efficiency Comparison

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The below comparison table is used for efficiency comparison between parameters delay, energy and throughput for 200 nodes.

Parameters	Delay	Energy	Throughput
PDORP	5.287	10.66	0.509
PDORP-LC	5.8	10.25	0.51

7. CONCLUSION

In this system an optimized routing protocol (PDORP) along with local caching (LC) is presented, which uses cache and directional transmission concept of both proactive and reactive routing protocols in a dynamic WSN environment. The performance of PDORP-LC has been evaluated by comparing with existing available methods PDORP and the results indicated that it performs better in most significant parameters viz Bit error rate, end to end transmission delay, energy consumption and throughput. The proposed work is performing in dynamic environment with the dynamic derivation of trusted nodes.

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