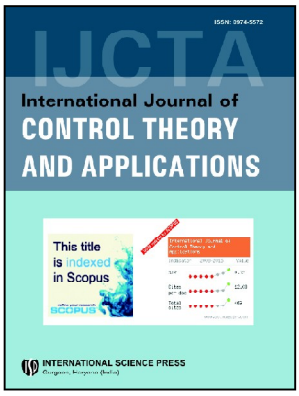

International Journal of Control Theory and Applications

ISSN : 0974-5572

Volume 10 • Number 11 • 2017

A Comprehensive Survey on Efficient Energy Consumption in Wireless Sensor Networks

V. Bibin Christopher[1], J. Jasper[2] and R. Isaac Sajan[3]

[1] *Research Scholar, Department of CSE, Ponjesly College of Engineering, Nagercoil.*
[2] *Professor, Department of EEE, Ponjesly College of Engineering, Nagercoil.*
[3] *Research Scholar, Department of CSE, Ponjesly College of Engineering, Nagercoil.*

Abstract: A wireless sensor network (WSN) is a wireless network consisting of spatially distributed autonomous devices using sensors to monitor physical or environmental condition like pressure, temperature, sound. Also the wireless sensor networks have been used in the field of army it is also used in the field of factories and health. The Sensor nodes are used for event detection, continuous sensing, event ID, location sensing also includes local control of systems. It has environmental applications where sensor networks include tracking the movements of small animal, insects and birds ; monitoring environmental conditions that affects livestock's and crops, irrigation; macro instruments in huge scale The wireless sensor networks works on the basis of inbuilt power which may be a Battery. In the system that exist the Leach protocol plays an important role and the important issue it has is energy consumption. The comparison has been made with various protocols and finally the result shows that PDORP protocol that is put forward which is a direction based protocol helps in reducing the energy consumption and it does so by finding the Best Path

1. INTRODUCTION

A sensor network design is affected by many factors, which include scalability, fault tolerance, production costs, operating environment, sensor network topology, hardware constraints, transmission media, and power consumption.

In the Wireless sensor networks the interaction with different hubs or sensing aspects broadens a huge amount of energy in collecting the information and transferring the obtained information. The major issue that is prevailed is that it may not be possible to send a information to the destination as there is a chance of battery being drained out. So many Scientist are aware of the fact that they need to develop the systems which may be power efficient so they basically look to use power efficient protocols. In order to optimize the WSN designs the scientists have considered many approaches. The major approaches include the 1) optimize the interaction layer 2) optimize the node hardware 3) optimize the cross-layer. But these approaches did not consider the features of wireless sensor networks so for that optimization using the hybrid algorithm was put forward and DSR protocol was also employed. The performance of routing protocols depends on the energy consumption from source to

sink. In this the main process while transmitting the information from source to destination is that we have a collection nodes from the collection of nodes we choose a cluster head (CH) in this there is a there are chances there may exist dead nodes so we then look at the second best shortest path. The major protocols that are included in finding the shortest path is PDORP protocol is which primarily a directional protocol in the PDORP protocol it includes the characteristics of proactive PEGASIS which is power efficient gathering information system and reactive DSR protocol which is dynamic source routing protocol. The implementation takes place in the application layer where in which traffic load is squeezed also in this node optimization takes place by strengthening battery utilization.In this another major concept that is utilized is cache memory which is a temporary memory.

In this we have major system modules as well as application modules. The system modules are Initialization of networks, Listening, Data Sensing and Absorption, Path Finding, Processing and Routing Integration, Transmission of data. In this initialization of networks means The system is assumed 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. The Listening means transmission between two nodes is possible only when the remaining energy of nodes is greater or equal to the threshold level of the energy. Some other assumptions about this model are as follows:1) Transmission power of node is adjusted by the node themselves and received signal strength (RSS) can be computed easily.2) Transmission and reception of packets are accomplished with the help of directional antennas.3)Nodes have the knowledge of their neighbors to transmit and receive the packets.4) Every sensor node is aware of the direction as per reference to local north. The Data Sensing and Absorption means a route for data transmission is established by using the path finding algorithm to find the optimal route in the large coverage set of nodes. If source node and destination nodes come under coverage set, then transmission will take place, otherwise again path searching. The path finding means If source node and destination nodes come under coverage set, then transmission will take place, otherwise again path searching. The processing and routing integration means, The proposed routing protocol has characterized with proactive and reactive phenomenon and used directional transmission in order to choose the shortest path towards the destination and cache memory ensures reliability and less delay by creating a trust list of nodes which results in less energy gets conserved by nodes. Finally hybrid optimization is used to select optimal path. By using Network creation algorithm randomly deployed nodes N(500). We have taken the area of 1000 square meters. We have computed the distance of d of all the nodes from their neighbors and we have compared their distance with the threshold the 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. The transmission of data means When a source node wants to transmit data to destination node, it calculate the distance from all the neighbors and forward the data to the node whose distance is less than or equals to the threshold distance and only in the minimum distance neighbour node should be in the direction of the destination node. After this process all the nodes in the direction of the destination are added into the trust list only in the first round of simulation. Whenever a new data transmission is required, then the trust list will be updated in the first round of simulation and the data will be transferred via only those nodes which are found in the trust vector. As the vector list is created only in the starting phase of the simulation so to continue the transmission thereafter vector list is stored in the cache which is created using the Routing Cache DSR Integration. The, fault tolerance, flexibility low cost, high sensing fidelity, and rapid deployment features of sensor networks generate many new and exciting application areas for remote sensing. In the future, this large range of application areas will make sensor networks an integral part of our life. However, understanding of sensor networks needs to satisfy the constraints introduced by factors such as fault tolerance, scalability hardware, topology change, environment cost and power consumption. Since these constraints are highly strong and specific for sensor networks, new wireless ad hoc networking techniques are required.

2. LITERATURE SURVEY

Currently, wireless sensor networks (WSNs) are used in many applications, namely, environment monitoring, disaster management, industrial automation, and medical electronics. Sensor nodes carry many limitations like low battery life, small memory space, and limited computing capability. Rajeev Kumar et al. (2016) studied to create a wireless sensor network more energy efficient, swarm intelligence technique has been applied to resolve many optimization issues in WSNs. In many existing clustering techniques an artificial bee colony (ABC) algorithm is utilized to collect information from the field periodically. Nevertheless, in the event based applications, an ant colony optimization (ACO) is a good solution to enhance the network lifespan. In this paper, we combine both algorithms (i.e., ABC and ACO) and propose a new hybrid ABCACO algorithm to solve a Nondeterministic Polynomial (NP) hard and finite problem of WSNs. ABCACO algorithm is divided into three main parts: (i) selection of optimal number of sub regions and further sub region parts, (ii) cluster head selection using ABC algorithm, and (iii) efficient data transmission using ACO algorithm. it use a hierarchical clustering technique for data transmission; the data is transmitted from member nodes to the sub cluster heads and then from sub cluster heads to the elected cluster heads based on some threshold value. Cluster heads use an ACO algorithm to discover the best route for data transmission to the base station (BS). The proposed approach is very useful in designing the framework for forest fire detection and monitoring. The simulation results show that the ABCACO algorithm enhances the stability period by 60% and also improves the good put by 31% against LEACH and WSNCABC, respectively.

Young-Duk Kim *et al.* (2013) stated one of principal design issues of a Wireless Sensor Network (WSN) for medical information systems is to classify received packets based on their priorities and guarantees so that they can be transmitted reliably, thus satisfying QoS requirements. In addition, when the target WSN requires multi-hop communications and the traffic load increases significantly, it is challenging to support both load balancing and suitable QoS at the same time. In this paper, we propose a new reliable protocol termed Cross-layer Channel Access and Routing (CCAR), which simultaneously supports both MAC and routing operations for medical-grade QoS provisions. CCAR initially determines the routing path with the lowest traffic load and low latency using newly defined channel quality factors. Concurrently, the source node allocates the predefined QoS Access Category to each packet and reserves the channel along the route. In addition, CCAR introduces an effective route maintenance scheme to avoid link failures in bottlenecked intermediate nodes, which prevents unnecessary packet drops and route rediscovery evocations. Finally, through both simulation studies and real test-bed experiments, we evaluate the performance of CCAR by comparing it with other conventional protocols, demonstrating that the proposed protocol can more efficiently support medical-grade QoS packets, especially when the network is heavily loaded.

Aarti Jain *et al.* (2015) Clustering is one of the widely used methods to save energy, increase spatial re usability, and scalability. Here it proposes a new fuzzy graph based modeling approach for wireless sensor network which takes into account the dynamic nature of network, volatile aspects of radio links and physical layer uncertainty. The fuzzy graph constructs fuzzy neighborhoods which are used to identify all the prospective member nodes of a cluster. For computation of optimum centrality of a cluster, we have defined a new centrality metric namely *fuzzy k-hop centrality*. The proposed centrality metric considers residual energy of individual nodes, link quality, hop distance between the prospective cluster head and respective member nodes to ensure better cluster head selection and cluster quality. Finally, a new computationally inexpensive clustering algorithm has been developed. The simulation results demonstrate that the proposed algorithm resulted in prolonged network lifetime in terms of clustering rounds, scalability, higher energy efficiency and uniform cluster head and cluster members distribution, as compare to LEACH-ERE and CHEF.

Chang Wook Ahn *et al.* (2002) 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 positional 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.

KOU Pan-gao *et al.* (2009) stated 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.

Stephanie Lindsey *et al.* (2002) stated 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.

3. NETWORK DESIGN

Initialization of networks

The system is assumed 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.

Listening

Transmission between two nodes is possible only when the remaining energy of nodes is greater or equal to the threshold level of the energy.

Some other assumptions about this model 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 have the knowledge of their neighbours to transmit and receive the packets.
- Every sensor node is aware of the direction as per reference to local north.

Data Sensing and Absorption

A route for data transmission is established by using the path finding algorithm to find the optimal route in the large coverage set of nodes. If source node and destination nodes come under coverage set, then transmission will take place, otherwise again path searching.

Path Finding

If source node and destination nodes come under coverage set, then transmission will take place, otherwise again path searching.

Processing and Routing Integration

The proposed routing protocol has characterized with proactive and reactive phenomenon and used directional transmission in order to choose the shortest path towards the destination and cache memory ensures reliability and less delay by creating a trust list of nodes which results in less energy gets conserved by nodes. Finally hybrid optimization is used to select optimal path.

By using Network creation algorithm randomly deployed nodes N(500). and have taken the area of 1000 square meters. We have computed the distance of d of all the nodes from their neighbors and we have compared their distance with the threshold the 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.

Transmission of data

When a source node wants to transmit data to destination node, it calculate the distance from all the neighbors and forward the data to the node whose distance is less than or equals to the threshold distance and only in the minimum distance neighbor node should be in the direction of the destination node. After this process all the nodes in the direction of the destination are added into the trust list only in the first round of simulation. Whenever a new data transmission is required, then the trust list will be updated in the first round of simulation and the data will be transferred via only those nodes which are found in the trust vector. As the vector list is created only in the starting phase of the simulation so to continue the transmission thereafter vector list is stored in the cache which is created using the Routing Cache DSR Integration.

4. COMPARISON OF RESULTS

Performance evaluation focuses on measuring the progress and process of achievement of project results and how inputs and outputs are producing outcomes and impacts. Performance evaluations are designed to identify accomplishments, performance issues, and constraints in the implementation of the project. It identify results and lessons learned in project implementation. The performance of the implemented system can be analyzed with the help of x-graph utility for generating 2-D graphs. The values for analyzing performance can be retrieved from trace files obtained during simulation using AWK scripts.

The performance analysis is done with the existing system DSR and the proposed system PDORP. The energy consumption is compared with the different 3 set of object movements. In the first set 100 objects are used. In the Second set 200 objects are used. In the third set 300 objects are used. The values are derived from the below table. As per the analysis it is proved that the energy level consumed by the proposed algorithm is less compared to the existing system. The less energy best path is always selected by the proposed method.

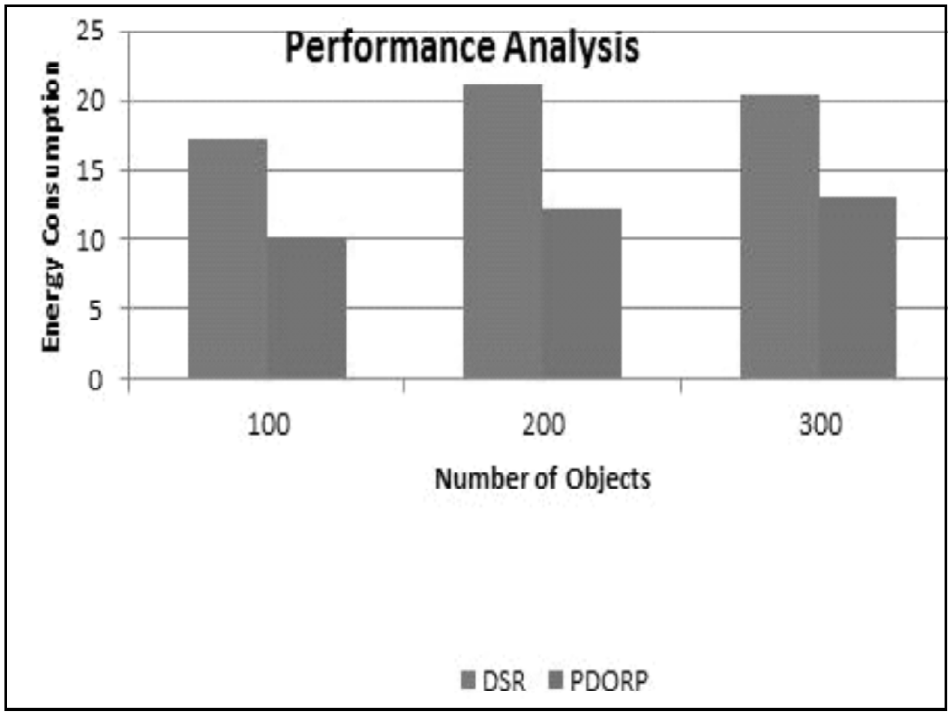

Figure 1: Performance analysis

Performance Graph

The Figure shows the performance graph of DSR and PDORP routing protocol. The graph finally conclude that PDORP routing protocol is the best algorithm for data transmission between the source and destination in the wireless sensor network.

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 performs better than PRP, OD-PRRP 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 away it can cause damage to existing routes. 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.

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.

Throughput

This metric average describes the rate of successful messages delivered over the network in a given time. As shown in. 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. The performance of PRP, PORP and OD-PRRP is almost similar in case of throughput.

End- End Transmission Delay

This parameter signifies the total amount of time taken by a packet for 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.

5. CONCLUSION

Detailed study on various existing energy efficient protocols were studied and the Comparison of the PDORP protocol has been done with various protocols and it is found that PDORP protocol uses less energy than any other existing protocols. The parameters used are Bit error rate, energy consumption, throughput, end to end delay.

REFERENCE

[1] Aarti Jain *et al.* (2015), "A Cross-Layer Channel Access and Routing Protocol for Medical-Grade QoS Support in Wireless Sensor Networks" Wireless Personal Communications, July 2014, Volume 77, Issue 1, pp 309–328.

[2] Chang Wook Ahn *et al.* (2002), "Optimal PID Governor Tuning of Hydraulic Turbine Generators With Bacterial Foraging Particle Swarm Optimization Algorithm" Proceeding of the CSEE » 2009, Vol. 29 Issue (26): 101-106.

[3] KOU Pan-gao *et al.* (2009), " A Genetic Algorithm for Shortest Path Routing Problem and the Sizing of Populations" IEEE Transactions on Evolutionary Computation,Volume: 6, Issue: 6, Dec 2002 Page(s)566 - 579.

[4] Rajeev Kumar *et al.* (2016), "Hybrid Swarm Intelligence Energy Efficient Clustered Routing Algorithm for Wireless Sensor Networks" Journal of Sensors 2016(3):1-19.

[5] Stephanie Lindsey et al. (2002), "Power Efficient gathering in sensor information systems" Aerospace Conference Proceedings, 2002. IEEE, 9-16 March 2002.

[6] Young-Duk Kim *et al.* (2013), "A Novel Method of Modeling Wireless Sensor Network Using Fuzzy Graph and Energy Efficient Fuzzy Based k-Hop Clustering Algorithm" Wireless Personal Communications May 2015, Volume 82, Issue 1, pp 157–181.