Load Balancing for Achieving the Network Lifetime in WSN-A Survey

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Abstract— a wireless sensor network is network form of sense compute, and communication elements which helps to observe, events in a specified environment. Sensor nodes in wireless sensor network are depends on battery power they have limited transmission range that's why energy efficiency plays a vital role to minimize the overhead through which the Network Lifetime can be achieved. The lifetime of network, depends on number of nodes, strength, range of area and connectivity of nodes in the network. In this paper we are over viewing techniques which are used in wireless sensor network for load balancing. Wireless sensor network having different nodes with different kind of energy which can be improve the lifetime of the network and its dependability. This paper will provide the person who reads with the groundwork for research in load balancing techniques for wireless sensor networks.

Keywords— wireless sensor network, load balancing, sensor node, overhead, network lifetime.

I. INTRODUCTION

This Wireless sensors networks consist of numerous minute sensor nodes to administer physical and biological conditions like high temperature, humidity, etc.where human involvement is not possible. A Wireless Sensor Network is a network which is a collection of sensor nodes which are self controlled through the radio links. Each node in the wireless sensor network has the ability of processing separately which contains numerous memory, transceiver and power resources These detecting devices i.e. sensors are legally responsible for data transmission from source location to destination location. Energy efficiency is the essential criteria for network lifetime enhancement. Sensor network is a subclass of ad hoc network and varies with it in terms of number of sensor nodes, allotment policy, failure rate, power etc. [1]. The main merit of a sensor network is that it includes power utilization constrain for sensor nodes using battery life. The ideal sensor network or node will be those which have least energy consumption in whole process in transmission.

Network lifetime is the mainly key metric for the assessment of wireless sensor networks and sensor nodes involved in WSN. In a resource-constrained situation, the use of each poor resource must be cautiously taken in consideration. The network can only accomplish its standard as long as it is considered "alive" in the network. It is as a result a metric for the highest efficiency a sensor network can offer. If the metric is used in an study preceding a real-life operation, the considered estimation of network lifetime can also include on to justify the cost of the utilization.[6] Lifetime is also measured a elementary limit in the position of accessibility and safety in networks. Network lifetime robustly depends on the lifetimes of the particular sensor nodes that generate the network. If the lifetimes of particular nodes are not expect correctly, it is possible that the resulting network lifetime metric deviates in an disobedient method. It should therefore be clear that a perfect and unswerving modeling of the single nodes is very key point in whole network life time. [8]

In Wireless Sensor network, sensor nodes have restricted power these sensor nodes have limited processing power, space and energy source, while the sink nodes have powerful resources to carry out several responsibilities with the sensor nodes. If once the nodes are installed at particular location, which reside at their locations for detecting responsibilities, node is select to promote the data based on its obtainable energy level and signal power. The enhanced energy in the node and farther the node from the previous one, In this process losing the energy efficiency and the network lifetime of the sensor nodes due to partial power of the battery in the entire network to build nodes and path energy proficient load balancing technique from source nodes to sink or target nodes has to be done to create a single energy efficient path from source node to sink node or target node that's why lifetime of the network can be amplified. Load balancing is a way for identical allotment of load across a network so that overcrowding does not take place. Identical allotment of load means workload is uniformly divided among two or more wireless sensor networks links. We considered necessary load balancing for achieve highest throughput, for achieve minimize response time, for interruption free network and for best possible resource utilization.

II. LITERATURE REVIEW

A. On the Lifetime of Wireless Sensor Networks [3]:

Yunxia Chen and Qing Zhao originated a general formula for the life span upgrading of wireless sensor networks which holds autonomously of the underlying network model ,network architecture protocol and data collection commencement. These formulas identify two key parameters at the physical layer of the network that influence the network lifetime means the channel status and the remaining energy of sensors. It provides a measure of performance valuation of the network model and increases the network lifetime. According to the formula, they proposed a MAC protocol this algorithm has utilized both the channel and

remaining energy information of each sensor node. This protocol approach, l maximizes the minimum residual energy across the network in each data compilation.

B. Local Load Balancing for Globally Efficient Routing in Wireless Sensor Networks [4]:

Ioan Raicu, Loren Schwiebert, Scott Fowler and Sandeep K.S. Gupta contributed by a new algorithm, e3D (energy-efficient Distributed Dynamic Diffusion routing algorithm), with a comparison done with two algorithms, i.e directed, and random clustering communication algorithm. The algorithm has been developed using set up cost with the analyzation of energy efficiency and useful life time of the network. The new algorithm has also been compared with the performance of optimum counterpart and an optimum clustering algorithm. This algorithm benefited with the cost of astronomical prohibitive synchronization costs. The comparison of the algorithm is done in terms of lifetime of the network system, distribution of power dissipation, synchronization cost, and simplicity of the algorithm.

C. Energy Efficient Adaptive Multipath Routing for Wireless Sensor Network [5]:

R Vidhyapriya and Dr P T Vanathi introduced energy efficient adaptive multipath routing technique .This technique utilizes the multiple paths between source and the sink node; it is also adaptive because of low routing overhead. This technique is intended to provide an environment with reliable transmission and also with low energy consumption, by efficiently utilizing the available energy and the strength of the received signal of the nodes, so that multiple routes to the destination can be identify. This algorithm proved that the energy efficient adaptive multipath routing scheme achieves much higher performance than the classical routing protocols even in the higher density nodes

D. Load-Balanced Routing Scheme for Energy-Efficient Wireless Sensor Networks [6]:

Fatma Othman, Nizar Bouabdallah and Raouf Boutaba study the conservation of potential energy which is achieved by balancing the traffic throughout. They studied and concluded distributing the traffic by multiple paths save more energy than the single path hence energy efficiency is increased in multi path system. For this a new analytical model for load balancing system has been introduced.

E. On the Lifetime of Wireless Sensor Networks [7]:

Isabel Dietrich and Falko Dressler introduced the algorithm to be used in analytic evaluations as well as in simulation models for focusing on a formal and concise definition of network that has been accumulated and its total network life time. This algorithm introduces some additional life time measures to the network life time. There new concept is to make network tolerance and disruption free. With another new additional feature is to fulfill the requirement in certain period of time other than every point of time. With this coverage and connectivity is also combined to form a single requirement called connected coverage. They proved that the connected coverage is different from non combined coverage and connectivity. It also supports the concept of graceful degradation by providing means of estimating the degree of compliance with the application requirements.

F. Load-Balancing Strategies for Lifetime Maximizing in Wireless Sensor Networks [8]:

Rahim Kacimi, Riadh Dhaou and Andr´e-Luc Beylot They analyzed and proposed the strategies to balance the energy consumption of the nodes and ensure maximum network lifetime by balancing the load as equally as possible assume that network lifetime corresponds to the instant when the first node dies. They also worked on the energy balancing strategies to extend sensor network lifetime. Based on load balancing techniques, they derived an optimal solution and propose a heuristic technique with comparison with, other routing techniques like equiprobability and shortest-path.

G. Energy Efficient Clustering Algorithms in Wireless Sensor Networks: A Survey [9]:

Vinay Kumar, Sanjeev Kumar and Sudharshan Tiwari introduced a survey which increases the network lifetime in Wireless Sensor Networks (WSNs) .Here the route for data transfer are selected in such a way that the total energy consumed along the path is minimized. For this clustering concept was used as cluster helps energy utilization in limited resources which extends and maximizes network lifetime.

H. An Energy Efficient and Load Balancing Routing Algorithm for Wireless Sensor Networks [10]:

Jin Wang, Tinghuai Ma and Jinsung Cho worked on the problem of hotspot, since this problem cannot be addressed under many routing because of energy depletion of sensor nodes. They proposed a Ring-based Energy Aware Routing (REAR) algorithm for wsn network that can achieve both energy balancing and energy efficiency for all sensor network nodes. This algorithm considers the hop number as well as the distance with the residual energy of the next hop node during routing..

I. Novel load balancing algorithms ensuring uniform Packet loss probabilities for WSN [11]:

J´anos Levendovszky, K´alm´an Tornai, Gergely Trepl´an and Andr´as Ol´ah developed a mechanism for optimal scheduling to forward packets in Wireless Sensor Network, where information gathering is done by clustering and cluster head with an already defined Quality of Service. The motive is to ensure balanced energy consumption and to minimize

the loss of packet probability, subject to time constraints (i.e. different nodes must send all their packets within a given time interval). Novel solutions for scheduling were developed by combinatorial optimization, and by quadratic programming methods. Here, the scheduling of forwarding packet is broken down to a discrete quadratic optimization problem and the optimum is sought by a Hopfield Neural Network yielding the solution in polynomial time. The scheduling which is given by Hopfield Neural Network indeed guarantees uniform packet loss probability for all the nodes and saves the cluster head energy. In this way, the longevity of the network can be improved and increased.

J. An Improved Approach in Clustering Algorithm for Load Balancing in Wireless Sensor Networks [12]:

J S Rauthan and S Mishra described WSN as next generation of sensing machines and structures with limited energy as most important drawback of wireless sensor nodes. In order to distribute the energy throughout the wireless sensor network, data load of the sensor nodes must be properly balanced. Clustering is one of the important mechanisms for load balancing. Clustering algorithms may result in some clusters that have more members than other clusters in the network and uneven cluster sizes negatively affect the load balancing in the network. The work they proposed improved a cluster algorithm for load balancing in clusters generation. WSNs efficiency is measured by the total distance between nodes to the base station and amount of data that has been transfer. Cluster–Head which is totally responsible for the creating cluster and cluster nodes may affect the cluster performance. They form an algorithm in which they chose Master Node and vice master node for regions and sub regions. To find out the master node they partition the region and find out the centre of region, by which they select the master node. For every partitioned portion again partition can be done if required and which depends on master node and nodes in that partitioned portion.

K. An Efficient Load Balancing Clustering Scheme for Data Centric Wireless Sensor Networks [13]:

K R Yadav, Vipin Pal, Girdhari Singh and R P Yadav defined Clustering as an efficient approach to capitalize the energy of sensor nodes which has energy as constraint in wireless sensor networks. Clustering schemes do not guarantee cluster formation with equal number of nodes. So data frames transmitted by the nodes vary. TDMA schedule of nodes of with smaller cluster formation than others results more number of data frames and hence more consumption of energy. The non consistent energy utilization of nodes affects the load balancing of network and these nodes are more prone to collapse earlier than other nodes. Here they found an improved scheme for cluster head selection. Clusters having variable frame slots for nodes are applied to E-LEACH and improved E-LEACH to make the cluster more balance in term of load. They Simulate using NS-2 simulator to analyze the performance of E-LEACH and improved E-LEACH with variable outline length.

L. Energy-Efficient Multi-Path Routing in Wireless Sensor Networks [14]:

Philipp Hurni and Torsten Braun concluded that multi-path routing is useful to achieve lifetime improvements by balancing the load on nodes and exploiting cross-layer information in WSN. A performance gain is achieved by altering path update rules on existing on-demand routing algorithms. Problems are identified with concurrent traffic along interfering paths as a direct consequence of special MAC protocol properties.

M. A Node-Centric Load Balancing Algorithm for Wireless Sensor Networks [15]:

Hui Dai and Richard Han researched that by spreading the workload across a sensor network, balancing the load reduces hot spots in the sensor network node and increases the energy lifetime of the sensor network. In this paper, they design a node-centric algorithm that constructs a load balanced tree in sensor networks of asymmetric structural design. They utilize a Sum metric to evaluate via simulation the balance of the routing trees produced by our algorithm. They find that implemented algorithm achieves routing trees that are more effectively balanced than the routing based on breadth-first search (BFS) and shortest-path obtained by Dijkstra's algorithm.

N. Load Balancing Techniques to Improve Life time Maximizing Wireless Sensor Network [16]:

In this paper Rahim Kacimi, Riadh Dhaou, André-Luc Beylot presents the lifetime maximization problem in wireless sensor networks. In such network prototype, all sensor nodes generate and send packets to a single sink or destination via multi-hop transmissions. They observed , in their previous experimental study, that since the complete sensor information have to be forward to a base station/node through multi-hop routing, the traffic model is extremely non-uniform, putting a high load on the sensor nodes close to the base station or sink node .

Also introducing some strategies that balance the energy consumption of these nodes they formalize the network lifetime maximization problem then derive an optimal load balancing solution.

O. On Maximizing the Lifetime of Wireless Sensor Networks Using Virtual Backbone Scheduling [17]:

In this paper Yaxiong Zhao, Jie Wu, Feng Li and Sanglu Lu present a novel sleep-scheduling strategy. This strategy is designed for WSNs has old-fashioned sensor nodes. The strategy forms multiple overlap backbones which work alternatively to prolong the network lifetime. The traffic is only promoted by supporting sensor nodes, and the remaining nodes turn off their radios to save energy. The turning round of multiple backbones makes sure that the energy utilization of all sensor nodes is balanced, which fully consumes the energy and achieves a longer network lifetime compared to the existing techniques.

P. On Improving the Lifetime of Wireless Sensor Networks Using Virtual Scheduling Backbone Replacement [18]:

In this paper D.Sharmila, R.Sujitha and G.Rajkumar studied the performance of Virtual Scheduling Backbone technique by combining Virtual Scheduling Graph based algorithm with Local Replacement algorithm and the combined algorithm is named as Virtual Scheduling Backbone Replacement algorithm technique. In which renewal of node based on energy plays a major role for the improvement of life span of network.

Q. Novel Load Balancing Scheduling Algorithms for Wireless Sensor Networks [19]:

In this paper Endre L´aszl´o, K´alm´an Tornai, Gergely Trepl´an and J´anos Levendovszky presented the optimal scheduling mechanisms and implemented method for packet forwarding in wireless sensor networks, where cluster heads gather information.[4] The motive is to observe real-life processes for a given time interval and forward packets with minimum loss probabilities to the base station. To achieve this objective they develop an optimal scheduling algorithm, which dictate the time slots through which packets must be sent by the nodes. The scheduling methodology guarantees that all the packets will be sent within a defined time slot and thus meeting delay constraints and also it provides identical packet loss probability for all the sensor nodes.

TABLE I
SUMMARY TABLE

Title	Publication	Authors	Facts	Findings
On The Lifetime Of Wireless Sensor Networks	IEEE COMMUNICATIONS LETTERS (2005)	Yunxia Chen, Qing Zhao	Proposed medium access control protocol utilizes channel state and residual energy information of individual sensors.	Medium access control protocol improves minimum residual energy of the network in each data collection.
Local Load Balancing For Globally Efficient Routing In Wireless Sensor Networks	International Journal Of Distributed Sensor Networks (2005)	Ioan Raicu, Loren Schwiebert, Scott Fowler, Sandeep K.S. Gupta	Proposed algorithm is best for achieving its goal to equally distribute the power dissipation in the network.	Complex clustering techniques are not compulsory to attain good load and power usage balancing.
Energy Efficient Adaptive Multipath Routing For Wireless Sensor Networks	IAENG International Journal Of Computer Science (2007)	R Vidhyapriya , Dr P T Vanathi	Proposed energy efficient adaptive multipath routing method utilizes multiple paths from source to the sink.	Proposed method achieves greatly elevated performance overcomes concurrent packet forwarding.
Load-Balanced Routing Scheme ForEnergy-Efficient Wireless Sensor Networks	Global Telecommunication Conference (2008)	Fatma Othman, Nizar Bouabdallah, Raouf Boutaba	Proposed load balanced routing method used for energy preservation through balancing the traffic throughout the WSN.	The distributing traffic generated by every sensor node through multiple paths instead of using a single path allows significant energy savings.
On The Lifetime Of Wireless Sensor Networks	ACM Transactions On Sensor Networks (2009)	Isabel Dietrich, Falko Dressler	Reviewing the presented definitions of network lifetime and introducing definition of sensor network lifetime	Doing analytical assessment as well evaluate particular algorithms and represent application necessities for extremely different sensor network
Load-Balancing Strategies For Lifetime Maximizing In Wireless Sensor Networks	IEEE ICC (2010)	Rahim Kacimi, Riadh Dhaou Andr´E-Luc Beylot	Studying the problem of energy utilization and lifetime maximizing in a many-to-one sensor network.	Addressing the network lifetime optimization for the WSN and describing the design and study of some energy balancing methods.
Energy Efficient Clustering Algorithms In Wireless Sensor Networks: A Survey	IJCSI International Journal Of Computer Science Issues (2011)	Vinay Kumar Sanjeev Jain Sudharshan Tiwari	Surveying the techniques of different clustering algorithms in WSN along with LEACH and successors.	Several energy efficient algorithms increase the network lifetime even if every effort has been made to offer absolute energy efficient clustering algorithms.

An Energy Efficient And Load Balancing Routing Algorithm For Wireless Sensor Networks	Comsis (2011)	Jin Wang, Tinghuai Ma, Jinsung Cho, Sungoung Lee	Proposed Ring-based Energy Aware Routing algorithm achieve both energy balancing and energy efficiency for all sensor nodes	The algorithm is superior in terms of energy hop number, consumption as well as network lifetime on average which achieve both energy efficiency and balancing
Novel Load Balancing Algorithms Ensuring Uniform Packet Loss Probabilities For WSN	IEEE (2011)	J´Anos Levendovszky, K´Alm´An Tornai, Gergely Trepl´An, Andr´As Ol´A	Proposed optimal scheduling mechanism for packet forwarding, which is broken down to a discrete quadratic optimization problem and the best is sought by a Hopfield Neural Network	The scheduling providing by the Hopfield Neural Network really guarantees identical packet loss probabilities for all the nodes and saves the energy of the cluster heads
An Improved Approach In Clustering Algorithm For Load Balancing In Wireless Sensor Networks	International Journal Of Advanced Research In Computer Engineering & Technology (2012)	J S Rauthan, S Mishara	Improving a cluster algorithm for load balancing in clusters	A network with minimum energy utilization as it involves energy minimizing techniques like multi-hop, clustering and data aggregation
An Efficient Load Balancing Clustering Scheme For Data Centric Wireless Sensor Networks	International Journal Of Communication Network And Security	K R Yadav, Vipin Pal, Girdhari Singh, R P Yadav	A proposed method for cluster head selection in which Clusters having changeable frame slots for nodes	A variable frame slot method is implemented to adjust the number of frame slots for smaller clusters also improve the performance of E- LEACH in terms of node death rate.
Energy-Efficient Multi-Path Routing In Wireless Sensor Networks	Springer (2008)	Philipp Hurni, Torsten Braun	Multi-path routing to attain lifetime improvements by load balancing and exploiting cross-layer information in WSN.	Integrate a multi-path routing protocol and appropriate MAC protocols with periodic wake-up to balance load in a WSN
A Node-Centric Load Balancing Algorithm For Wireless Sensor Networks	Global Telecommunication Conference (2003)	Hui Dai, Richard Han	A node-centric algorithm that constructs a load balanced tree in sensor networks of asymmetric architecture	Achieves routing trees that are more efficiently balanced than the routing based on breadth-first search and shortest-path
Load Balancing Techniques For Lifetime Maximizing In Wireless Sensor Networks	Ad Hoc Networks 11 (2013)	Rahim Kacimi, Riadh Dhaou, André-Luc Beylot	Propose some techniques for balance the energy utilization of sensor nodes and ensure maximum network lifetime by balancing the traffic load	Optimal solution and heuristic outperform the traditional routing schemes in terms of network lifetime.
On Maximizing The Lifetime Of Wireless Sensor Networks Using Virtual Backbone Scheduling	IEEE TRANSACTIONS ON PARALLEL AND DISTRIBUTED SYSTEMS (2012)	Yaxiong Zhao, Jie Wu, Feng Li, Sanglu Lu	Introducing a novel sleep-scheduling method has redundant sensor nodes and forms multiple overlapped backbones	Combines back bone scheduling and duty cycling technique is presented for achieving redundancy in wireless sensor network
On Improving The Lifetime Of Wireless Sensor Networks Using Virtual Scheduling Backbone Replacement	IEEE Conference On Information And Communication Technologies (2013)	D.Sharmila, R.Sujitha, G.Rajkumar, Ramesh Govindan, Deborah Estrin	Studying Virtual Scheduling Backbone Replacement (VSBR) algorithm in which replacement of node based on energy for the improvement of life span of network.	Collision avoidance and loss of channel during sharing of channel information is avoided

IV. CONCLUSIONS

Wireless Sensor Network are deployed in various areas where human involvement is not possible like environment monitoring, earthquake and woodland fire discovery etc. essential issues implicated in Wireless Sensor Networks are improving the lifetime of network and reducing battery or power. . In this paper we are over viewing techniques which are used in wireless sensor network for load balancing. Wireless sensor network having different nodes with different kind of energy which can be improve the lifetime of the network and its dependability. This paper will provide the person who reads with the groundwork for research in load balancing techniques for wireless sensor networks.

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