International Journal on Future Revolution in Computer Science & Communication Engineering
Volume: 4 Issue: 3
ISSN: 2454-4248
102 – 106

A Comparative Analysis of Various Techniques For Energy Conversation Through Clustering And Energy Aware Routing In WSNs

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***Abstract*—**Applications of sensor networks become an emergent technology, which might monitor a particular space and collect eco-friendly information around an area. In recent years, low power wireless communication and also the availability of low cost and tiny micro sensor nodes result in increased enhancements of wireless sensor network applications in real society. A sensor is an autonomous device for monitoring physical as well as environmental conditions. Main contest in the field of WSN is energy conservation through route optimization. In this paper, we analyzed the various techniques used by the different researchers for efficient energy conservation through the clustering as well as energy aware routing. Both of techniques work on various parameters and have some limitations as well.

Keywords*-*WSN, Energy conservation, Route optimization, Clustering, Energy aware routing

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I. INTRODUCTION

Wireless sensor Networks (WSNs) is an indispensible part of our life as a result of its observation and security aspects. A good range of applications makes it important for us. WSN consists of variety of sensor nodes that work along with one another to accomplish a typical task (e.g. surroundings observation, object trailing, etc.) and reports the collected knowledge through a wireless interface to a middle node (sink node). The areas of applications of WSNs vary from civil, military and environmental to health care. Samples of applications consist of forest fireplace detection, target trailing in battlefields, civil structure observation and patient monitoring [1] etc.

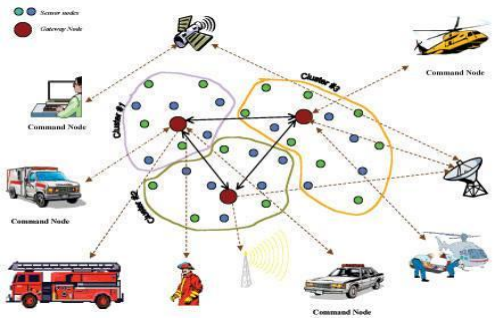

Figure 1: Wireless Sensor Network

A wireless sensor network (WSN) may be a distributed sensing technology that may be used to monitor natural phenomenon and may be simply deployed [2]. Sensor devices are equipped with a little silicon chip, a tiny low battery, a radio transceiver, and a group of transducers that want to acquire information that reflects the changes within the surrounding environment of the sensor node [1].

Sensor networks are divided into two categories. In event-driven networks, knowledge is distributed whenever a happening happens and in continuous dissemination networks, each node sporadically sends knowledge to the sink [2, 11] and topology of sensor network depends upon the application. Deployment and topology define the overall network structure that includes number and distribution of nodes, their transmission range, the distance between neighbors, type of routing paths, type of communication etc [3].

II. IMPORTANT FACTORS FOR AN EFFICIENT SENSOR NETWORK DESIGN

A. Energy conservation:

It is incredibly necessary for sensor networks. However, the most important drawback of reducing sensor node's energy consumption has not been solved absolutely. If all sensor nodes transmit packets on to the base station, the farthest nodes from the base station can die early. On the opposite hand, whereas sending packets through multiple hops, sensors nearest to the base station tend to die early, leaving some network areas fully unmonitored and inflicting network partitions known as holes. So as to maximize the WSNs life, it's essential to prolong every individual sensor node's life by minimizing transmission energy consumption and causing packets via ways which will avoid sensor nodes with low energy and so, minimize the overall transmission power. To beat the matter of energy - constraint in WSNs completely, different researchers are engaged on different aspects like power-aware mackintosh protocol, topology management, transmission power management etc. [2].

B. Energy Consumption:

Energy Consumption deals with the distribution of energy among all the nodes throughout the network.

C. Quality of Service (QoS):

It depends upon high routing potency beneath multi-hop transmission circumstances. Concentrate on each the energy consumption and routing potency [4].

III. VARIOUS TECHNIQUES FOR ENERGY CONSERVATION

A. Clustering Technique

In this technique, clustering is employed to save lots of the energy consumption. In clustering method, sensors nodes are organized into distinct teams, known as clusters and every cluster contains an arranger known as the cluster head (CH)

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and remaining nodes act as cluster members (CMs). Every sensing element node should belong to one and only one cluster. Sensing element nodes send their perceived knowledge to their corresponding CHs. CHs then aggregate them and send it to an overseas base station known as sink via single hop or multi-hop communication [5].

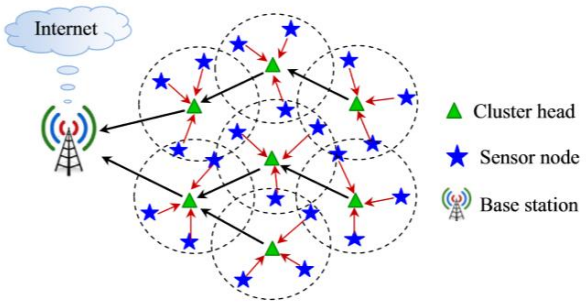

Figure 2: A wireless sensor network model based on cluster [6]

Sukhkirandeep Kaur and Roohie Naaz Mir [3] introduced a replacement cluster approach for WSN that has load equalization and improves energy potency by precise choice of CH's. Analysis and simulation results demonstrate the effectiveness of the projected approach.

Tarachand Amgoth and Prasanta K. Jana [5] introduced energy aware routing formula for cluster based WSNs. The formula relies on a sensible strategy of cluster-head (CH) alternative, remaining energy of the CHs and therefore the distance between clusters, for cluster formation. To assist data routing, a directed virtual backbone of CHs is made that is rooted to the sink. The projected formula is additionally incontestable to balance energy consumption of the CHs throughout data routing method. It was also verified that the formula achieves regular message and linear time complication.

Pratyay Kuila and Prasanta K. Jana [6] classified Linear/ nonlinear Programming (LP/NLP) formulations of the issues of energy efficient clustering and routing pursued by two projected algorithms supported particle swarm optimization (PSO). The routing formula is developed with multi-purpose fitness operate and a good particle coding system. The clustering algorithm is projected by considering energy conservation of the nodes through load equalization. The algorithms tested and established in relations of network life, energy depletion, dead sensing element nodes, and delivery of total data packets to the base station.

Chengfa Li et al. [9] developed Energy Efficient Unequal Clustering (EEUC) technique for periodical records gathering in wireless sensing element networks. It divides the nodes into clusters of uneven size, and clusters nearer to the base station have tiny size as compared to the cluster far-off from the base station. Therefore, cluster heads nearer to the base station will maintain some energy for the inter-cluster knowledge transferring. They also presented an energy-conscious multiple hops routing protocol for the inter-cluster communication.

B. Energy Aware Routing Technique

Routing could be a serious issue in WSN. Any routing protocol designed to be used in WSN ought to be reliable, energy-efficient and may increase the period of time of the network. Therefore, a routing protocol designed for these networks ought to definitely be specified the power consumption at every stage is as low as doable and therefore the network period of time should be unbroken at its most.

Jalel Ben et. al [1] presented Energy economical and Quality of service, multipath routing protocol (EQSR) that optimized the network life by reconciliation energy consumption among many nodes, with the attention of service segregation to present permission to delay vital traffic to achieve the sink node inside a suitable delay, reduces the end to end delay through distributing the traffic across multiple ways, and enhances the throughput by introducing knowledge repetition. EQSR uses the residual energy, the accessible buffer size of node and signal-to-noise ratio (SNR) to forecast the simplest next hop.

R. Vidhyapriya and P.T. Vanathi [2] presented a reactive routing protocol known as energy aware routing method that produces a reliable transmission atmosphere with low energy consumption. This protocol expeditiously utilizes each the energy accessible within the node and quality of the link to spot the simplest doable route to the destination.

Piyush Charan et. al [4] compared two analytical models that demonstrate and forecast the QoS in terms of throughput, average end-to-end delay, jitter, and energy consumption. Different network models are grid-based and cluster-based. Each one simulated with QualNet v vi.1 machine.

Sudip Misra and P. Dias Thomasinous [7] provided a straightforward, energy-efficient, least time routing protocol with one-level information aggregation that creates positive improved time period for the network. The protocol was evaluated with famous ad hoc and sensor network routing protocols. It absolutely was examined that the projected protocol performed well in throughput, average energy utilization, latency and average network life time. The new projected protocol uses node energy and absolute time because the constraint for routing, this ensures trustiness and congestion hindrance.

Shashidhar Rao Gandham et al. [8] presented the preparation of multiple mobile base stations to increase the period of the detector network. Moreover, lifetime of the sensor network divides into equal slots of your time referred to as rounds. Base stations are repositioned at the start of a round. The planned scheme consumes associate whole number (integer) linear program to pick new positions for the base stations and a flows-based routing procedure to form definite power efficient routing during every round.

Dionisis Kandris et al. [10] planned PEMuR, a novel twin proposal for efficient video communication, that aims at each high QoS attainment and energy saving. PEMuR proposes the collective use of associate degree intelligent video package

programming algorithmic program with associate degree energy-conscious hierarical routing protocol. The accepted routing protocol permits the selection of the foremost energy efficient routing ways, controls the network load in keeping with the energy remains of the nodes associate degreed avoids useless information communications through the projected use of an energy threshold. During this manner, an excellent level of energy potency is obtained. The planned packet programming algorithmic program facilitates the decline of the video communication rate with the borderline potential raise of distortion.

TABLE I. TABLE OF ANALYSIS

z	Author	Year	Technique	Advantages	Disadvantages
8	Shashidhar Rao Gandham, Ravi Prakash, Milind Dawande and S. Venkatesan	2003	Multiple Base Stations	• It efficiently either reduced or retained the hop count of every sensor node in the network. • Effectively lessen the energy expenditure per message delivered. • To augment the lifetime of a sensor network	• It is difficult to determine the total number of base stations. • Increased overheads in the selection of next base station.
9	Chengfa Li, Mao Ye, Guihai Chen, Jie Wu	2005	(EEUC) Energy Efficient Unequal Clustering method	• studyingthe cluster head characteristics of the uneven clustering algorithm • examine how EEUC balances the power utilization of the cluster heads and thus prolongs the network life span • Calculate each node's energy consumption from data transmission and aggregation per round	• It is difficult to determine the optimal value of definite parameters according to network scale
3	Sukhkirandeep Kaur Roohie Naaz Mir	2016	load balancing and improves power competence by precise selection of CH's	• Variable cluster sizes are formed in the network. • More number of CH provides efficient results • Cluster far from sink node has more number of nodes while cluster near sink node has very few nodes which prevent the problem of energy drainage of nodes near sink node.	• In this approach, precise assignment of nodes is presented in a cluster. • This network is considered for stationary nodes.
7	Sudip Misra, P. Dias Thomasinous	2010	A effortless, least-time, energy-efficient routing protocol with one-level data aggregation that ensures improved life time for the network.	• Projected protocol was compared with routing protocols, AODV, DSR, DSDV, DD, and MCF. • Projected protocol outperformed in throughput, latency, average power utilization and average network lifetime.	• It is suitable only for a simple and small network. • More work is to be done on security, reliability and fault tolerance.
4	Piyush Charan1, Tahsin Usmani1, Rajeev Paulus2, Syed Hasan Saeed1	2016	Two analytical models which display and foresee the QoS in terms of throughput, jitter, average end-to-end delay, and power utilization.	• Compared the diverse parameters like power utilization, average end to end delay and throughput for star and grid network topology	• the network throughput decreases When packets per second increases • The average end-to-end wait increases in both star and grid-based network situations.
5	Tarachand Amgoth, Prasanta K. Jana	2014	An energy-aware routing algorithmic rule for wireless sensing element networks known as ERA. The algorithm consists of clustering and routing phases.	• Ensure that each one the CHs ought to participate in information routing method and at constant time their relaying load is balanced with respect their residual energy Comparisons are created by considering two situations of node studying random and grid	• Did not take into account the dynamic situation and fault-tolerant aspects of the detector network
6	Pratyay Kuilan, Prasanta K. Jana	2014	Linear and nonlinear Programming of routing and cluster issues planned 2 algorithms for identical supported particle swarm optimization	• Algorithms are tested with many situations of WSNs by variable variety of sensor nodes and gateways. • The results have shown that the algorithms perform higher in terms of energy consumption, network life, range of inactive sensing element nodes, range of hops and therefore the total information packets transmission.	
10	Dionisis Kandris, Michail Tsagkaropoulos	2011	PEMuR, a novel dual method for efficient video communication, which target at both power	• outstanding level of power efficiency is attained • Not only proposes a power efficient route selection policy but also manages the network	• It may work with the inadequate available channels so there is a requirementof scalability

	, Ilias Politis, Anthony Tzes, Stavros Kotsopoulos		reduction and high QoS attainment with the collective use of an energy-aware hierarchical routing protocol and an intelligent video packet scheduling algorithm	load according to the power residues of the nodes and prevents useless information transmissions.	
1	Jalel Ben, Othman, Bashir Yahya	2010	(abbreviated shortly as EQSR) Energy Efficient and QoS aware multipath routing protocol that maximizes the network life span through balancing energy utilization across multiple nodes	• Decreases the end to end delay by spreading out the traffic during multiple routes • Increases the throughput through data duplicacy • EQSR uses the residual power, node available buffer size and Signal-to-Noise Ratio(SNR) to forecast the best next hop through the routes construction stage	• Further analysis necessary to study the impact of the buffer size, network size and path length on the performance metrics
2	R. Vidhyapriya and P.T. Vanathi	2007	A reactive routing protocol named power aware routing that is intended to provide a consistent transmission environment with low power utilization.	• Competently utilizes both the power available in the node and quality of the link to recognize the best possible path to the destination.	• More research is to be necessary improve the packets delivery ratio and to diminish the average delay

IV. SUMMARY OF THE VARIOUS TECHNIQUES

The most demanding research topic in WSN is the energy conversation because energy is the most crucial part of it. Therefore, energy saving routing algorithm designing is one of the most paying attention research areas. Lots of routing solutions which are specifically designed for WSNs have been suggested. Some of the techniques are based on clustering and others are based on energy aware routing techniques.

To extend the lifetime of wireless sensor networks (WSNs) Energy efficient clustering and routing are two well-known optimization problems which have been studied broadly [6]. Different routing techniques are negotiation based, multi-path based, QoS based, and query based. Many of the researchers work on the following Performance metric such as load balancing, Reliability, fault tolerance, data aggregation, standard end to end holdup, packet delivery ratio and average power utilization. Comparison between star and grid network topology on the basis of following parameters energy consumption, average end to end delay and throughput is made [4]. An ideal routing protocol for WSN should be simple, less computation, efficient in power utilization and improve the network lifetime [7]. Multiple base stations can be employed and periodically change their locations to extend the lifetime of a sensor network, it effectively reduces the energy consumption [8].

In the clustering techniques total area is separated into the number of clusters each one having the cluster head, which is selected under certain criteria and parameters i.e. topology, cluster distribution, cluster count. Square grid topology is taken and new clustering approach with load distribution is implemented depending upon the application to be used, the ideal number of nodes acting as cluster head can be found [3]. Energy utilization of the CHs is significantly balanced and the lifetime of the network is enhanced. It is based on the derivation of effective particle encoding method and fitness function for routing and clustering separately [9].

V. CONCLUSION

In the current scenario sensors are used by almost all the fields for the security and safety purpose. In WSN battery has the limited capacity so there is a need of energy conservation that can be achieved by energy-aware routing or clustering. Both of the techniques are discussed and analyzed. Clustering effectively reduces the energy consumption and augments the life span of a sensor network but it is very difficult to determine total number of base stations and to select the next base station. More work is to be done on assignment of nodes in a cluster and suitability in the dynamic environment. Energy aware routing ensures to recognize the finest possible path to the destination. It performs better in terms of network life, outstanding level of energy efficiency, number of hops and the total data packets transmission. Scalability is required to improve the performance.

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