Review of Energy Enhancements of Modified LEACH

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Abstract— Energy efficiency is the main issue in the Wireless Sensor Networks (WSN). The concept of cooperative communication is one of the fastest growing areas of research in wireless sensor networks. The energy consumption is minimized using cooperative communication technique. Number of techniques has been proposed in minimizing the energy consumption in wireless sensor networks. In this paper, the various techniques proposed for minimizing the energy consumption have been discussed. This is done primarily to give an overview of the various techniques known today for minimizing the energy consumption in wireless sensor networks.

Key words: Wireless Sensor Networks, Sensor Node, LEACH, Cluster Head

I. INTRODUCTION

In this era wireless sensor networks (WSNs) create a center of attention the researchers further due to their possible applications in weather analysis. The promising field of wireless sensor networks integrates sensing, calculation, and sharing into a private portable device based on the current modifications in micro electromechanical systems (MEMS) technology [2]. WSN can be useful nearly in any environment which calls for observation prior to taking an appropriate action. Development of a wireless system is less expensive and has numerous uses in surrounding monitoring, home building security, bio-habitat observation, disaster organization etc. Wireless Sensor Networks are categorized into proactive and reactive sensor networks. In Proactive sensor networks, nodes at regular intervals switch on their sensors and transmitters, sense the atmosphere and transmit the data on hand with them. These proactive sensor networks are appropriate for applications that require data monitoring at standard intervals.

Alternatively, in Reactive sensor networks, nodes respond to only some events that occur at their end, like noting a great change in the sensed feature. So, reactive sensor networks are appropriate to deal with time crucial systems. Sensor Networks are generally data centric, in which information are requested based on assured attributes similar to the example in which sensors recording above 100° F report to the enquiry generated by sink. This is unlike from the conventional networks, where information is requested from a definite node. WSN term can be mostly sensed as devices variety from mobile phones, laptops or PDAs to very small and simple sensing devices. Currently, the majority of available wireless sensor devices are significantly controlled in terms of computational power, memory, competence and communication abilities due to financial and technology reasons. This is the reason most of the study on WSNs has determined on the design of power and computationally proficient algorithms and protocols, and the functional domain has been restricted to simple data oriented observation and reporting uses. Wireless Sensor Network nodes are battery supplied which were implemented to carry out a specific assignment for a comprehensive period of time may be years. If WSNs nodes are more powerful or mains supplied devices in the surroundings, it is useful to utilize their computation and communication resources for complex algorithms. New network architectures with various devices and expected advances in knowledge are eliminating current limitations and expanding the range of possible applications for WSNs significantly.

II. RELATED WORK

This section represents the existing work related to the wireless sensor network. Mainly of the routing protocols have been proposed for wireless sensor networks. Routing in the wireless networks are categorized into 3 types based on the structure of the network. They are Flat Routing, Hierarchical Routing and Location Based Routing. In Flat Routing all the nodes of the network performs the same functionality and work together to collect the data and routing to the destination. Hierarchical routing, also known as cluster-based routing considered as a two layer architecture where one layer is engaged in cluster head selection and the other is responsible for routing. A cluster head in hierarchical routing is the node which is responsible for collecting data from other nodes in the cluster, aggregating all data and sending the aggregated data to the base station. LEACH is the foremost algorithm in these hierarchical and in the past decades several variants of LEACH have been employed to achieve energy efficiency [1]

In LEACH protocol, the sensor nodes are combined together and form a local cluster. Among all sensor nodes one node acts as a cluster head inside the local cluster. A randomized rotation technique a cluster head is used by this protocol whose main aim is to distribute the energy load equally among all the sensors in the network which ultimately gives result of a longer life to the node's battery. The major role of cluster head is to collect data from their respective clusters and aggregate those collected data and finally sent to the base station. In this manner, LEACH enable scalability and robustness for dynamic network and incorporates data fusion into the data gathering process to reduce the amount of data to be transmitted.

The operation of LEACH is divided into two phases and these phases are further divided in same sub-phases. Each LEACH round begins with a set-up phase and a steady state phase. Set up phase is used to choose a cluster head and steady state phase is used to maintain the cluster head during the transmission of data.

LEACH is a protocol that tends to reduce energy consumption in a wireless sensor network. However, LEACH uses single-hop routing in which each sensor node transmits information directly to the cluster-head or the sink.

Some of the limitations of LEACH routing protocol are,

- Cluster heads sends aggregated data to the base station in single hop manner so consumes lot of energy.
- Distribution of the cluster head is not uniform. Some of the clusters may have cluster may have cluster head at the edge of the cluster.
- Cluster heads are predefined typically taken as 5% or 10% of total deployed nodes.

III. MODIFIED ALGORITHMS FOR LEACH

M. BaniYassein, A. Al-zou'bi, Y. Khamayseh, W. Mardini [2] presented an overview of LEACH protocol implementations, then proposed a new version of LEACH protocol called V-LEACH protocol. From the simulation results, number of conclusions can be made. The first: number of messages created by the V-LEACH is less than the messages created by the original LEACH. The second: if messages created by the new version are less that means the network energy remaining using V-LEACH is more than the remaining network energy using the original LEACH. That means the new version of LEACH outperforms the original version of LEACH protocol.

Ben Alla, Ezzati Abdellah, Abderrahim Beni Hssane, Moulay Lahcen Hasnaoui [3] presented IB-LEACH, an extension of the LEACH, which improves the stable region of the clustering hierarchy and decrease probability of failure nodes using the characteristic parameters of heterogeneity in networks. In these networks some high energy nodes called NCG nodes (Normal node or Cluster Head or Gateway) become "cluster heads" to aggregate the data of their cluster members and transmit it to the chosen "Gateways" that requires the minimum communication energy to reduce the energy consumption of cluster head and decrease probability of failure and this increase the lifetime of the network. Simulation results shows that the IB-LEACH achieves better performance in this respect, compared to SEP and LEACH in both heterogeneous and homogenous environments. In this paper it is supposed that nodes called NCG nodes are distributed randomly and fixed.

Vivek Katiyar, Narottam Chand, Gopal Chand Gautam, Anil Kumar [4] presented Improvement in LEACH Protocol for Large-scale Wireless Sensor Networks In this paper an improvement in LEACH protocol has been proposed to overcome the shortcoming i.e. existence of very large and very small clusters in the network at the same time. This leads to the decrease in lifetime of WSNs. In this paper, it proposes and analyzes a new energy efficient clustering protocol (FZ-LEACH) that eliminates the above problem by forming Far-Zone. Far-Zone is a group of sensor nodes which are placed at locations where their energies are less than a threshold. The simulation results and analysis show that proposed FZ-LEACH algorithm outperforms LEACH in terms of energy consumption and network lifetime. Simulation results prove the improvement in the performance in the original LEACH protocol in terms of energy dissipation rate and network lifetime. It is found that FZ-LEACH protocol saves around 30% energy of sensor network in comparison to LEACH.

D. Mahmood, N. Javaid, S. Mahmood, S. Qureshi, A. M. Memon, T. Zaman [5] presented MODLEACH. MODLEACH tends to minimize network energy consumption by efficient cluster head replacement after very first round and dual transmitting power levels for intra cluster and cluster head to base station communication. In MODLEACH, a cluster head will only be replaced when its energy falls below certain threshold minimizing routing load of protocol. Hence, cluster head replacement procedure involves residual energy of cluster head at the start of each round.

Bilal Abu Bakr, Leszek Lilien [6] presented A Quantitative Comparison of Energy Consumption and WSN Lifetime for LEACH and LEACH-SM. Extending the period of operation (lifetime) of wireless sensor networks (WSNs) is one of the most critical issues. Their limitations are caused by limited energy resources. To achieve WSN lifetime extension, we propose the LEACH-SM protocol, which modifies the prominent LEACH protocol by providing an optimal energy-saving spare management, including spare selection. LEACH-SM extends WSN lifetime while maintaining the minimum required coverage throughout the WSN lifetime. Other features of LEACH-SM are: spare selection at the beginning of its operation (allowing sensor nodes in all clusters to make their primary/spare decisions in parallel), reducing transmission of redundant data to cluster heads, and maintaining scalability by using only local information.

Lu Jianyin [7] presented Simulation of Improved Routing Protocols LEACH of Wireless Sensor Network, this paper introduces compression ratio, takes the surplus energy of nodes as a pivotal factor in cluster-head node selection, proposes an improved algorithm of the optimal number of cluster heads with the minimum energy consumption and provides the computational formula for obtaining the optimal number of cluster heads, and proves by mathematical reasoning and by simulation experiments. The improved algorithm is a success in terms of balancing energy consumption of the system and prolonging the network life cycle, thus leaving the network more of robustness

Suyog Pawar, Prabha Kasliwal [8] presented Design and Evaluation of En-LEACH Routing Protocol for Wireless Sensor Network. This paper takes into account the assumption in LEACH i.e. each sensor node contains equal amount of energy which is not valid in real scenarios. Enhanced LEACH protocol (En-LEACH) has been adaptable to handle non-uniform energy distribution characteristic of a dynamic sensor network. En-LEACH is more effective; producing high level information about the environment in an energy-efficient way. En-LEACH is able to handle non-uniform energy distribution of sensor nodes which is an important characteristic of a dynamic sensor networks. In En-LEACH, cluster-head depending upon energy left in the node, all cluster members are kept informed about the status of their cluster-head, since the probability of failure of cluster head is high during data transmission phase .This provision is missing in LEACH protocol. Hence it is bound to perform better than LEACH

Ningbo WANG, Hao ZHU [9] presented an Energy Efficient Algorithm Based on LEACH Protocol .In this paper, effectiveness of LEACH protocol is analyzed in extending the lifetime for energy-constrained wireless sensor networks. An improved protocol LEACH-R is proposed based on LEACH protocol. LEACH-R improves

the selection of cluster-head and proposes to choose relaying node compare to LEACH. Residual energy of the nodes is considered during selection of cluster-head, possibility of low energy nodes being selected as cluster-head is reduced. Based on both residual energy and distance to base station, relaying node is chosen from cluster heads to become the relay node between base station and other cluster-heads. The simulation result suggests LEACH-R protocol could balance network energy consumption and extend the network life cycle more effectively and proves the improvement in the performance in the original LEACH protocol in terms of energy dissipation rate and network lifetime. It is found that LEACH-R protocol saves around 20% energy of sensor network in comparison to LEACH.

Hongqin Liu, Shaochuan Wu [10] presented Improvements of LEACH Protocol in Wireless Sensor Networks. This article analyzes the mechanism of clustering in LEACH protocol and presents improved approaches based on energy of sensor node and the distance between the node and the base station, then compares their performances. Two improved protocols: LEACH-E and LEACH-ED are presented in this paper. LEACH-E considers residual energy of nodes in phase of cluster head selection and LEACH-ED takes into account both the residual energy of nodes and the distance between the base station and nodes. Results of simulation indicate that the improved protocols can balance the network load and prolong the network lifetime.

Shuo Shi, Xinning Liu and XuemaiGu [11] presented an Energy-Efficiency Optimized MAX_LEACH for Wireless Sensor Networks. MAX_LEACH is a cluster algorithm in which cluster heads are randomly selected from the nodes with energy above the average, and the simulated annealing algorithm is utilized to find the optimal solution with better position to reduce the energy loss of cluster heads. It provided an energy-efficiency optimized MAX_LEACH through a modified model of the cluster head energy consumption considering retransmission and acknowledgment, and the secondary simulated annealing algorithm is utilized to get a better solution.

Geon Yong Park, Heeseong Kim, HwiWoonJeong, and Hee Yong Youn [12] presented A Novel Cluster Head Selection Method based on K-Means Algorithm for Energy Efficient Wireless Sensor Network. In this paper we propose an efficient cluster head selection method using K-means algorithm to maximize the energy efficiency of wireless sensor network. It is based on the concept of finding the cluster head minimizing the sum of Euclidean distances between the head and member nodes. . This is mainly due to effective selection of the CHs such that the distances between the CH and the member nodes become minimal. We have proposed to group the sensor nodes into several clusters by using K-means algorithm in this paper.

IV. CONCLUSION

It has been observed in literature review that Extended Heterogeneous LEACH protocol for wireless SNs the energy efficiency, extended life time and improved system stability make EHE-LEACH an attractive protocol for wireless SNsIn order to improve the stability of the network system and lifetime Observations show that EHE-LEACH has better lifetime and stability of the system as compared with LEACH and SEP for same energy level. We compared EHE-LEACH with LEACH and other all protocol techniques mention in literature review table but due to the presence of various clustering algorithms that we need to evaluate and in future other factors can have an effect on the network lifetime. For future work, a model with heterogeneous wireless sensor nodes with its topology to have good energy efficient and increasing lifetime network may be investigated in different future requirements.

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