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Performance Enhancement of Scalable Energy Efficient Clustering Hierarchy Protocol using overlap sensing ratio in Wireless Sensor Networks

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ABSTRACT

Energy consumption of sensor nodes in wireless sensor networks (WSNs) is a big challenge for improving network lifetime. Several approaches have been proposed in existing literature for this. One of the best approach can be considered as clustering. During clustering strategy, cluster head (CH) selection plays an important role because CH is responsible for collecting data from the member nodes, processing and forwarding the data to next level or sink. In this paper proposed, minimization energy consumption using overlap sensing ratio approach that connect with rotational angle for path connectivity for sink position and a network by selecting optimal CH in WSNs using energy and distance and no of overhead parameters. We alsocompare with existing approach SEECH protocol with our proposed approach SEECHOSR (Scalable Energy Efficient Clustering Hierarchy Protocol using overlap sensing ratio) to enhance overall lifetime of network parameter based on rotational-shaped design using MATLAB 2014Ra

Keyword- Wireless Sensor Network, Clustering, rotational -shaped clustering

I.INTRODUCTION

1.1 Wireless Sensor Networks

Wireless sensor network emerging as a promising and interesting area. Wireless Sensor Networks (WSN's) are being used in surveillance, industrial monitoring, traffic monitoring, habitat monitoring, health care monitoring, air pollution monitoring, forest fire detection, land slide detection, water quality monitoring, natural disaster prevention, industrial monitoring, cropping monitoring, machine health monitoring and crowd counting etc. which calls for monitoring before taking an appropriate action. The WSN is built from a few to several hundreds or thousands of nodes, where each node is connected to one or sometimes several sensors. Each such sensor network node has typically several parts: a radio transceiver with an internal antenna or connection to an external antenna, a microcontroller, an electronic circuit for interfacing with the sensors and an energy source, usually a battery or an embedded form of energy harvesting.

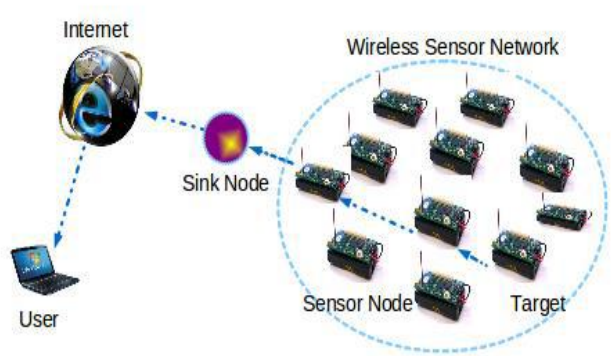

Figure: 1 Basic Architecture of Wireless Sensor network

Wireless sensor network can be categorized into two types: Unstructured WSN and Structured WSN. In unstructured WSN, the nodes are densely deployed and also the nodes can be deployed in ad-hoc manner in the sensing area or region. In Structured WSN

Sensor node developments of some or all nodes are preplanned. The nodes placement is also planned. So, the maintenance of structured WSN is much easy as compare to Unstructured WSN.

1.2. LOW-ENERGY ADAPTIVE CLUSTERING HIERARCHY (LEACH):

LEACH is the first and most popular energy-efficient hierarchical clustering algorithm for WSNs that was proposed for reducing power consumption. LEACH is based on an aggregation technique that combines the original data into a smaller size of data that carry only meaningful information to all individual sensors. LEACH divides the a network into several cluster of sensors, which are constructed by using localized coordination and control not only to reduce the amount of data that are transmitted to the sink, but also to make routing and data dissemination more scalable and robust. LEACH uses a randomize rotation of high-energy CH position rather than selecting in static manner, to give a chance to all sensors to act as CHs and avoid the battery depletion of an individual sensor and die quickly. LEACH uses single-hop routing where each node can transmit directly to the cluster-head and the sink. Therefore, it is not applicable to networks deployed in large regions. While LEACH helps the sensors within their cluster dissipate their energy slowly, the CHs consume a larger amount of energy when they are located farther away from the sink.

In LEACH algorithm each round is consist of two states:

(a) Setup State: during this step a cluster head is selected for that round.

(b) Steady State: In this phase the nodes send data to the cluster head.

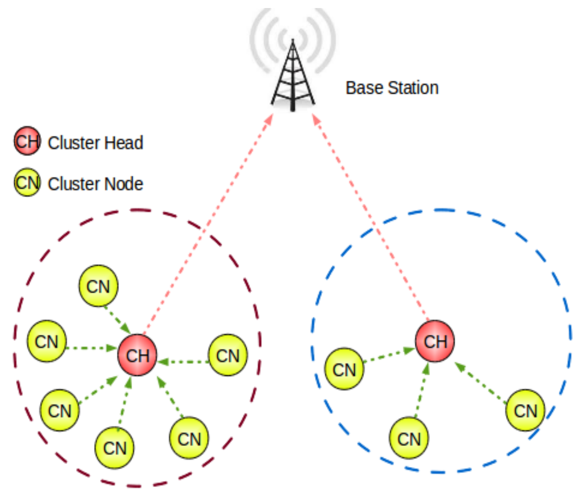

Figure 3: Illustration of LEACH Protocol

The major characteristics of this Protocol are as follows:

1. It rotates the cluster heads in a randomized fashion to achieve balanced energy consumption

2. Sensors have synchronized clocks so that they know the beginning of a new cycle,

3. Sensors do not need to know location or distance information.

There are some drawbacks of this protocol such as:

1. LEACH uses single-hop routing where each node can transmit directly to the cluster-head and the sink. Therefore, it is not applicable to networks deployed in large regions.

2. The idea of dynamic clustering brings extra overhead, e.g. head changes, advertisements etc., which may decrease the gain in energy consumption.

3. Random election of CH, hence there is Possibility that all CHs will be concentrated in same area.

4. The protocol assumes that all nodes begin with the same amount of energy capacity in each election round, assuming that being a CH consumes approximately the same amount of energy for each node.

This protocol is most suited for constant monitoring such as monitor machinery for fault detection and diagnosis.

1.3. Clustering Model

In clustering, the sensor network is divided into different clusters. Each cluster has a representative node known as CH and other are cluster members. Member nodes do not communicate directly with the sink node or BS. They have to forward the aggregated data to the CH. The CH will perform aggregation of the received data from member nodes and sends it to the BS.

Assume that N nodes are spread in a field. Our goal is to identify a set of CHs which cover the entire network efficiently. Each node is associated with exactly one cluster. The node can directly communicate with its CH.

The following requirements must be met:

1) Clustering is completely distributed.

2) Clustering should be terminated within a fixed number of iterations. At the end of each node is either a CH or a cluster member.

3) In terms of Processing complexity and number of message exchange clustering algorithm should be efficient.

4) CHs are well-distributed over the network so that it cover entire network efficiently.

1.4. Cluster Head Selection

In WSN, the data transmission from source (node) to destination (BS) is via CH to eliminate the problem of power/energy consumption. There are different strategies used for CH selection. In DR & DDR, CH selection is based on the distance between CH and BS [11-12]. The internal concentric square (close to the BS) need not to form CH, the nodes of that region directly communicate with the BS. While outer concentric squares form centre of there region as reference point and the node closer to it become CH and in next round next closest node becomes CH and so on. In IDDR, CH selection is based on the residual energy of the node in each round. Node having highest residual energy selected as CH in every round [13]. In SEECH, numbers of nodes having high degree of neighboring nodes introduce themselves to the network called CH candidates. Then their residual energy is calculated but for selecting CH priority, it is given to the node having high degree. In SEECH one more candidate is selected called relay used to transmit data from CH to the BS [14].

1.4. Overlap sensing ratio region

The effect of whole neighboring sensors on the current node was taken into account in the virtual centripetal force-based

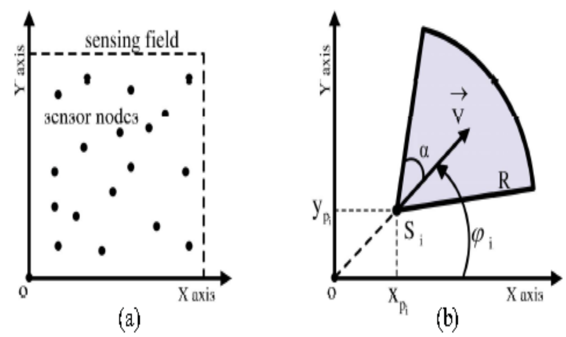

Fig. 4. Sensing field and directional sensing model.

coverage-enhancing algorithm (VCFCEA) [15]. It adjusted nodes' direction based on a novel centripetal force model.The overlapping region of each node was quantized by the centripetal force. And each node rotated the corresponding angle according to the value of centripetal force. Rotating direction was decided by the direction of centripetal force.

However, VCFCEA required nodes to sequentially calculate virtual force coming from each neighboring sensor so that the computational complexity was increased due to the vector calculus. Besides, VCFCEA shut off redundant sensors simultaneously to prolong the network lifetime. But there is a potential problem on the occurrence of sensing blanks for this strategy.

Considering the above deficiencies, first we introduce the parameter of OSR to describe the effect of the whole neighboring sensors. Different from centripetal force, the scalar operation of OSR reduces the computational complexity. Second, by establishing the reasonable mapping relationship between OSR and rotation angle, the network coverage obtains a further enhancement compared with VCFCEA Furthermore, a modified strategy of shutting off redundant sensors is presented to prolong the network lifetime.

II.LITRATURE REVIEW

Jin Wang, Menglin Wu and Jeong-Uk Kim [1]Wireless sensor networks commonly consist of a large number of tiny sensor nodes that are deployed either inside we propose an energy-efficient competitive clustering algorithm for wireless sensor networks using a controlled mobile sink. Clustering algorithm can effectively organize sensor nodes and the use of a controlled mobile sink node can mitigate hot spot problem or energy holes. The selection of optimal moving trajectory for sink nodes is an NP-hard problem. In our algorithm, we firstly study an competitive clustering algorithm in which cluster heads are rotated in each round and selected mainly based on their competition range and their residual energy. Besides, we use mobile sink node instead of fixed sink node. The mobile sink node moves at a certain speed along a predefined path and sojourn at some park position to collect data packets. Simulation results validate that competitive clustering algorithm outperforms LEACH and the use of mobile sink node significantly improve the performance of the sensor network.

S.Suganyadevi and N.Subhashini [2]Energy hole problem is a critical issue for data gathering in wireless sensor networks. Sensors near the static sink act as relays for far sensors and thus will deplete their energy very quickly, resulting energy holes in the sensor field. This project proposed a mobile sink-based adaptive immune energy-efficient clustering protocol (MSIEEP) to alleviate the energy holes. A MSIEEP uses the adaptive immune algorithm (AIA) to find the optimum number of cluster heads (CHs) to improve the lifetime and stability period of the network. The performance of MSIEEP is compared with the previous protocols; namely, low-energy adaptive clustering hierarchy (LEACH), rendezvous, and mobile sink improved energy-efficient PEGASIS-based routing protocol using Network Simulator (NS2). Simulation results show that MSIEEP is more reliable and eliminates the energy hole problem and improves the lifetime and the stability of the wireless sensor network.

Archana B Biradar, V.V.Ayyannavar [3]Wireless Sensor Networks consist of hundreds of tiny, inexpensive, resource constrained sensor nodes. Routing is a challenging task in such environment mainly due to the unique constraints the wireless sensor networks suffer from. The proposed protocol is hierarchical and cluster based. The selection procedure is carried out in two stages. In the first stage, all candidate nodes for becoming CH are listed, based on the parameters like relative distance of the candidate node from the Base Station, remaining energy level, probable number of neighbouring sensor nodes the candidate node can have, and the number of times the candidate node has already become the Cluster Head. Simulation results show that the proposed routing scheme significantly reduces energy consumption and increases the lifetime of sensor network compared to other hierarchical routing schemes such as Low-Energy Adaptive Clustering Hierarchy (LEACH).

Gurpreet Kaur, Dr. Sandeep Sharma [4]The quick escalations in network multimedia devices have permitted extra concurrent digital services: video conferencing, online playoffs as well as remote learning to nurture for conform e-net jobs. WSNs have become major area of research in computational theory due to its wide-ranging applications. But due to limited battery power the energy expenditure has become key drawback of WSNs protocols. Although several protocols has been proposed so far to improve the energy efficiency more however still a lot enhancement can be done. GSTEB has shown fairly significant results over the on hand WSN protocols. The general purpose of this work is to find the problems of the former techniques for WSNs. At the end of this paper appropriate future guidelines are given to further improve this work.

Harleen kaur, Dr.Tanupreet singh [5]Wireless sensor networks (WSNs) are becoming popular in real life applications. Because of the top features of the resource-constrained and battery-aware sensors, in WSNs energy utilization has found to be always a major interesting subject of research. WSNs compose battery-powered nodes, which are linked to the beds base station to for many actions or task. As sensor nodes are battery-powered i.e. can be dead after the consumption of the battery that is also called duration of WSNs. So utilizing the energy in well-organized way, may end in prolonging the duration of the

WSNs. Sensor nodes possess a negative characteristic of limited energy, which pulls back the network from exploiting its peak capabilities. Hence, it is essential to gather and transfer the data in a optimized way which reduces the vitality dissipation. In this paper, a survey on various mobile sink based clustering protocols is presented. From the survey, it has been concluded that none of the technique performs effectively in all fields.

J.M. Rabaey [6] proposed that analyzed a method to elect cluster heads according to the energy left in each node. The assumption of global knowledge of the energy left in the whole network makes this method difficult to implement. Even a centralized approach of this method would be very complicated and very slow, as the feedback should be reliably delivered to each sensor in every round.

R.S.Chang, C.J Kuo [7] it proposes a maximum energy cluster head routing protocol which has self configuration and hierarchical tree routing properties. The proposed protocol improved LEACH in several aspects such as it constructs clusters based on radio range and the number of cluster members and the cluster topology in the network is distributed more equally.

J. Zhao, A.T. Erdogan [8] a novel self –organizing energy efficient hybrid protocol based on LEACH is presented, combining cluster based architecture and multiple-hop routing. Multi-hop routing is utilized for inter-cluster communication between Clusterheads and the base station, instead of direct transmission in order to minimize transmission energy.

Heinzelman, et al. [9] introduced a hierarchical clustering algorithm for sensor networks, known as Low-Energy Adaptive Clustering Hierarchy (LEACH). LEACH is a cluster-based protocol that applies randomized rotation of the cluster heads to distribute the energy load evenly among the sensor nodes in the network. The operation of LEACH is organized in rounds, each consisting of a set-up phase and a steady-state phase. During the set-up phase, the network is separated into clusters, each with a randomly selected cluster head from nodes in a cluster. During the steady-state phase, the cluster heads gather data from nodes within their clusters respectively, and fuse the data before forwarding them directly to the sink. LEACH provides sensor networks with many good features, such as clustering-based, localized coordination and randomized rotation of cluster-heads, but expends much energy in cluster heads when directly forwarding data packets to the sink.

Lindsey et al. [10] presented an enhanced LEACH protocol. The protocol, Power Efficient Gathering in Sensor Information Systems (PEGASIS), assumes that all nodes have location information about all other nodes, and that each can send data directly to the base station. Hence, the chain of PEGASIS is constructed easily using a greedy algorithm based on LEACH. Each node transmits to and receives from only one of its neighbors. In each round, nodes take turns to be the leader on the chain path to send the aggregated data to the sink. To locate the closest neighbor node in PEGASIS, each node adopts the signal strength to measure the distance of all neighbor nodes. However, the global information of the network known by each sensor node does not scale well and is not easy to obtain. Since a sensor network generates too much data for the end-user to process, it has to aggregate the data.

V. PROPOSED IMPLEMENTATION

Firstly we will discuss the energy model used in our proposed scheme.

5.1. Energy Model

We adopt the radio energy model described in [3] and shown in fig. 3.1, where the transmitter needs energy to run the radio electronics and power amplifier while the receiver needs

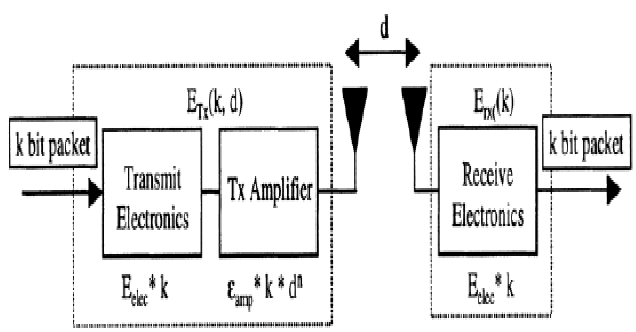

Figure 5.1: Radio energy dissipation model

energy to run the radio electronics. The free space (*d*2 power loss) channel scalable model is used where d is the distance between the transmitter and receiver. Power must be controlled to compensate the loss and ensure a certain power level at the receiver by setting the power amplifier properly. To transmit a *k*-bit packet for a distance of *d*, the radio expends the following energy:

ETx(k,d) = ETx-elec(k) + ETx-amp(k,d)
=k*Eelec+k*Eamp*d2
(5.1)

For receiving k-bit data, the energy consumed is
ERx(k,d) = ERx-elec(k)=k*Eelec
(5.2)

Here, Eelec is the energy consumed by the electronic circuitry which depends on various factors related to coding, modulation, and filtering of signal occurring before it is sent to the transmission amplifier. For the experiments presented in this Thesis, we adopt the values given in [5]: Eelec = 50 nJ/bit, Eamp = 100 pJ/bit/m2. A sensor node also consumes 5nJ/bit/message for data aggregation [7, 8]. We are assuming that all data packets are of same size.

5.2 ALGORITHM FOR OSR-SEECH

The segments for lower energy node consumption formulation & 2 categories of important things to estimate the k-coverage probability in a network with log-normal investigation (however the shadowing distribution can be slightly random and without coverage sensing area of higher energy shifting nodes.

2. Sensors node uses quadrature technique or a modest analytic formula for coverage sense with advance node energy.

3. The new composite high-dimensional uses in quadrature approaches for low dimensions and quasi-random integration for higher (n>2) computes coverage probability for a network with Rayleigh fading (exponentially circulated with unit mean) and log-normal shadowing.

4. We present a modification of variables motivated by the dimensional spherical coordinates.

5. When Node i has some data to transmit, it will reexamine the desirable paths towards sink node and the Node i analyze the Path P = {P1,P2,P3,_ _ _ _ _ _ _ ,PN}based upon their cost information. Node i measures the path information on the basis of Residual Energy (REp), Next Hop, Neighbor ID (Nidp) & Available Bandwidth (bwp).

6. The path with higher REp is chosen and If all the path have identicalREp then,Path with maximum bwp is preferred and data is transmitted through the selected P.

VI. EXPERIMENTAL RESULT

In this section, the existing and the proposed methods are compared. In this existing system, in order to enhance the coverage area a Coverage-Enhancing Algorithm is used based on overlap sense ratio. By adjusting the sensing direction of the nodes of SEECH, the coverage area is increased with the reduction of computational complexity. The performance of the SEECH protocol is compared with those of the OSR with-Coverage- ratio via an extensive series of simulations. The simulations using different protocols are ceased once all nodes run out of energy, and the comparison results generated. In the case the same network model in both approaches mentioned above is used to examine the protocols. The SEECH and the SEECHOSR both set their ***BS*** in a remote place, and each node can directly transmit data to the ***BS***. Such a condition, however, is not suitable for a real-world environment, because each tiny low-cost sensor node does not have such strong communication capability.

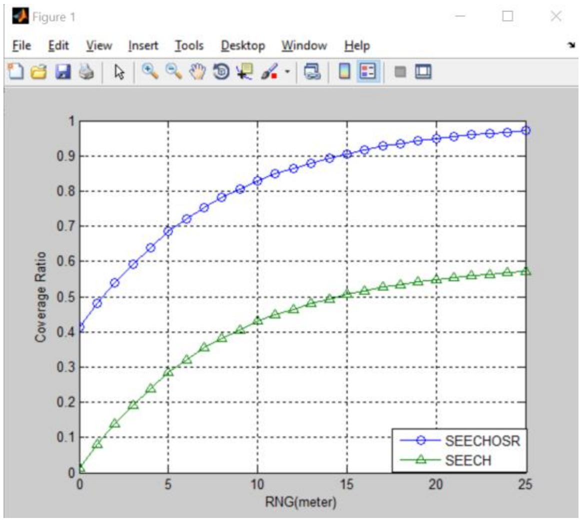

Figure 6.1: Coverage ratio for SEECHOSR max 0.9712 at 25-meter distance

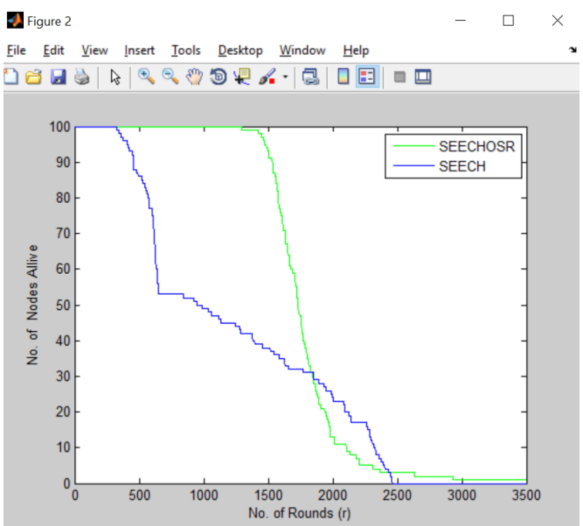

Figure 6.2: No of alive nodes for SEECHOSR with max no of round 1650 rounds alive .

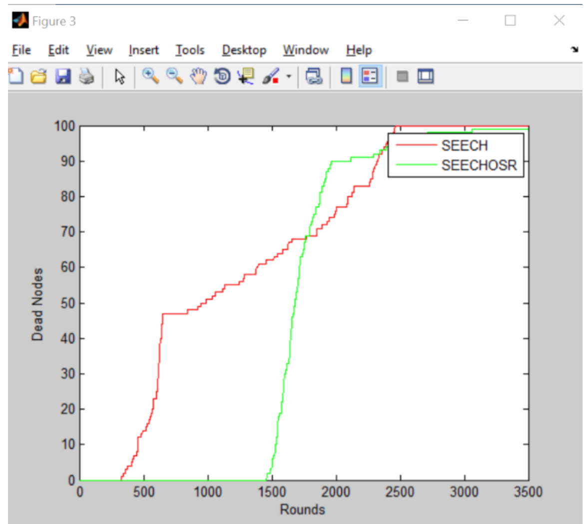

Figure 6.3: No of dead node for SEECHOSR with max no of round 1496 rounds alive.

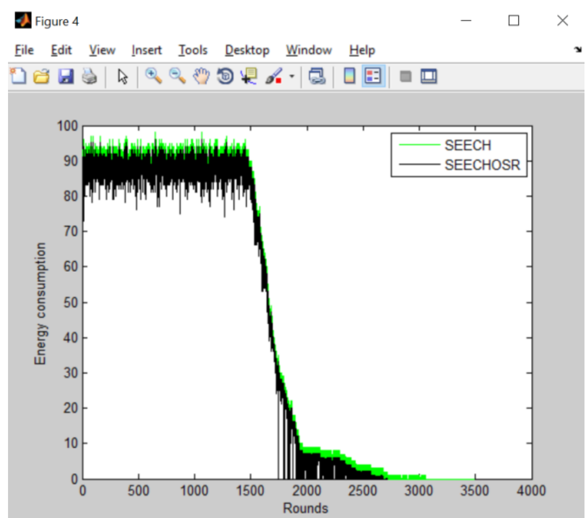

Figure 6.4: Energy consumption for SEECHOSR with max no of round 2520 rounds alive.

VII.CONCLUSION

The proposed technique in which the distance and the residual energy of the nodes is considered by providing them weight age value using optimization algorithm i.e. Genetic Algorithm which optimizes the results and provides the best solution that is enough to obtain best results for improving network's lifetime. Compared with the conventional SEECH protocol the proposed protocol increases network lifetime significantly and also improves the energy efficiency of the wireless network. The proposed protocol of the paper generates desired results and hence can be termed as en efficient and effective energy efficient protocol in wireless sensor networks.

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