Volume 5, Issue 6, June 2015 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

# Geometry Based Efficient Routing Protocol in Wireless Sensor Network

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***Abstract— Wireless sensor networks are capable of observing the environment, processing data, and making decisions based on these observations. Wireless sensor network are the composed of number of sensor nodes with a limited energy.WSN having tremendous applications like education, health care, retail, sciences and monitoring. As the WSN works on limited battery power, it affects the network lifetime. In this paper we focuses on both coverage area as well as network lifetime. In the proposed Geometry Based Efficient Routing Protocol we use the concept of voronoi for the better coverage area and we define a protocol that favors those nodes being more energy-redundantly covered as better candidates for cluster heads and select active nodes in a way that tries to emulate the most efficient tessellation for area coverage. Our simulation results validate our computation and show the significant improvement of the network coverage lifetime.***

***Keywords— Sensor network, Clustering, Routing, Voronoi, Geometry***

## I. INTRODUCTION

A wireless sensor network (WSN) is a composed of small sensor nodes deployed in large numbers to sense the real world. Each node possesses the capacity for wireless communications in order to facilitate data transmissions between nodes.[1] Wireless sensor networks (WSNs) provide reliable monitoring from very long distances. These networks are basically data gathering networks in which data are highly correlated and the end user needs a high level description of the environment sensed by the nodes. The nodes in wireless sensor networks are usually deployed either randomly in the working environment or they might be positioned in specific locations. In both cases, it is required to prolong the network lifetime as much as possible in order to ensure that sensing functionality is still provided for the maximum period of time.

In WSN, the sensor nodes directly transmit their sensing data to the Base Station (BS) without any coordination between the two. However, in Cluster-based WSNs, the network is divided into clusters. Each sensor node exchanges its information only with its cluster head (CH), which transmits the aggregated information to the BS. Aggregation and fusion of sensor node data at the CHs cause a significant reduction in the amount of data sent to the BS and so results in saving both energy and bandwidth resources.[2] A number of factors must be considered before WSNs are implemented, including power consumption ,fault tolerance, sensing coverage, coordination and network security. Examples of WSN-based applications include military surveillance, environmental monitoring and home automation[1].

This paper studies the works done in solving the coverage problem as well as limited battery power. . In This Paper we deploy sensor nodes on an irregular geographical area. To apply deployment schemes on irregular geographical target area, we propose to include the concept of voronoi diagram based approach in WSNs, to provide a way of dividing an irregular geographical area into a number of regular regions. Network clustering groups nodes into clusters according to their geographical proximity. In a cluster, a node serves as a cluster head (CH) and all the other nodes in this cluster serve as cluster members (CM). Sensor scheduling selects only a subset of sensor nodes to be sensing active such that the area covered by these active nodes (viz., network coverage) can still be the same as the one covered by all nodes.

The rest of this paper is organized as follows. Section 2 reviews related work, Section 3.explain our geometry efficient routing protocol and its performance is evaluated in Section 4.Simulation and Results Finally, Section 5 concludes this paper.

## II. RELATED WORK AND MOTIVATION

In the literature,many clustering protocols have been proposed for WSNs,e.g. LEACH,HEED,TEEN.Low Energy Adaptive Clustering Protocol(LEACH) is a Self organizing, adaptive clustering protocol that uses randomization to distribute the energy load evenly among the sensors in the network.In LEACH, the nodes organize themselves into local clusters, with one node acting as the local base station or the cluster head. In the In the hybrid energy-efficient distributed (HEED) clustering protocol introduced by Younis and Fahmi [04], minimum degree nodes, maximum degree nodes, or average minimum reachability power (AMRP) can be chosen to form a cluster. a distributed position-based network protocol called minimum energy communication network (MECN) with the aid of GPS receivers to have node positions was proposed by Li and Halpern. Manjeshwar et al. [05] designed a threshold-sensitive energy-efficient sensor network (TEEN) protocol to increase network coverage by employing a hierarchical clustering approach.

 

In [06]LSEC introduce by Fuad Bajaber,The LSEC determines the active and non active nodes. In order to do this, LSEC calculates the distance between member nodes within the cluster. If neighboring sensor node within cluster can cover the current node's sensing area or part of it,this sensor node can be turned off during current frame.During the current frame, each active node sends its data during its allocated transmission time slot. Upon receiving data packets from its cluster nodes, the cluster head aggregates the data before sending them to the base station. In next frame, the non active nodes switch on their circuits and enter into active mode while active nodes can switch off the radio and enter into sleep mode.[07]The data density correlation Degree clustering method for data aggregation in WSN (DDCD) by Fei Yuan, Yiju Zhan, and Yonghua Wang highlight the problem that the recent spatial correlation models of sensor nodes' data are not appropriate for measuring the correlation in a complex environment. [08] Ying Liao, Huan Qi, and Weiqun Li proposed Load-Balanced Clustering Algorithm With Distributed Self-Organization for Wireless Sensor Networks. The basic idea of DSBCA is based on the connectivity density and the distance from the base station to calculate *k* (clustering radius). The clustering radius is determined by density and distance: if two clusters have the same connectivity density, the cluster much farther from the base station has larger cluster radius; if two clusters have the same distance from the base station, the cluster with the higher density has smaller cluster radius.

[09] Energy-Efficient Routing Protocol for Wireless Sensor Networks with Static Clustering and Dynamic Structure by Huei-Wen Ferng · Robby Tendean · Arief Kurniawan utilizes virtual points in a corona-based wireless sensor network, static clusters with dynamic structures are formed in ERP-SCDS. Moreover, next-round cluster heads are selected in advance to avoid a deadlock when the old cluster heads die. Finally,a simple relay node selection mechanism instead of a complicated multi-hop route discovery algorithm is further designed for ERP-SCDS. Integrating these mechanisms enables ERP-SCDS to form balanced cluster sizes to prolong the network lifetime. Bin Li, Hongxiang Li, Wenjie Wang,Qinye Yin, and Hui Liu introduces [10] This paper considers random wireless sensor networks where nodes are distributed randomly and form clusters to transmit the packets to relay clusters using cooperative multi-input-multi-output (CMIMO) technique. Efficient and Secure Routing Protocol forWireless Sensor Networks through SNR Based Dynamic Clustering Mechanisms [11] by Subramanian Ganesh and Ramachandran Amutha The proposed scheme,which is an efficient and secure routing protocol for wireless sensor networks through SNR-based dynamic clustering (ESRPSDC)mechanisms, can partition the nodes into clusters and select the cluster head (CH) among the nodes based on the energy, and non CH nodes join with a specific CH based on the SNR values. Error recovery has been implemented during the inter-cluster routing in order to avoid end-to-end error recovery. Security has been achieved by isolating the malicious nodes using sink-based routing pattern analysis.

## III. PROPOSED PROTOCOL

### *A. Voronoi concept*

Voronoi diagrams provide a powerful technique for analyzing computational geometric problems. Voronoi diagram divides the plane containing the set of sites of interest into multiple polygons in accordance with the distance between each site and every point on the plane.[1 2]. To get the voronoi field on the irregular shaped area following steps are involved:first, sensor s1 determines the perpendicular bisector L12 after discovering neighbouring node s2 (see Fig. 1a). Second, sensor s1 determines the intersection of L12 and L13 after discovering neighbouring node s3 (see Fig. 1b). The intersection of L12 and L13, that is V123, is a shared Voronoi vertex of sensors s1, s2 and s3.Third, vertices V145 and V125 are determined using the same procedure after sensor s1 has discovered s4 and s5 (see Figs. 1c and d, respectively). Finally, the Voronoi cell of sensor s1, that is V(c1), is defined by the Voronoi vertices V123, V134, V145 and V125 (see

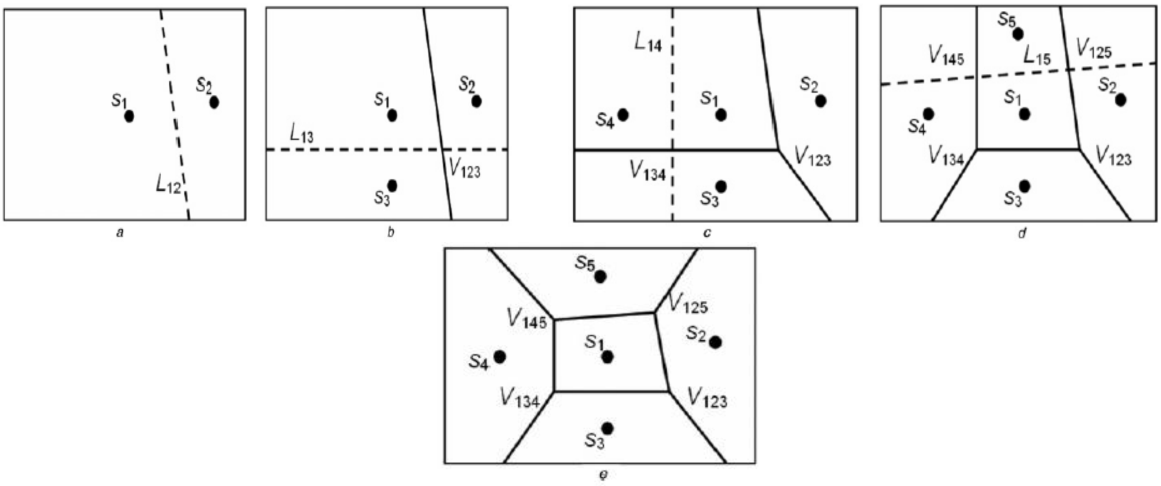


Fig.1 Process of Voronoi field

### *B. Geometry Efficient Routing Protocol (GERP)*

*1.Information Update:* In this stage the sensors randomly deployed in an irreregular shaped area and the information update is first performed at the network initialization stage where each node exchanges their location and energy information with their neighbors within the range of 2Rs. In this paper, we assume that all nodes have known their own location information by using either a GPS unit or network localization technique.

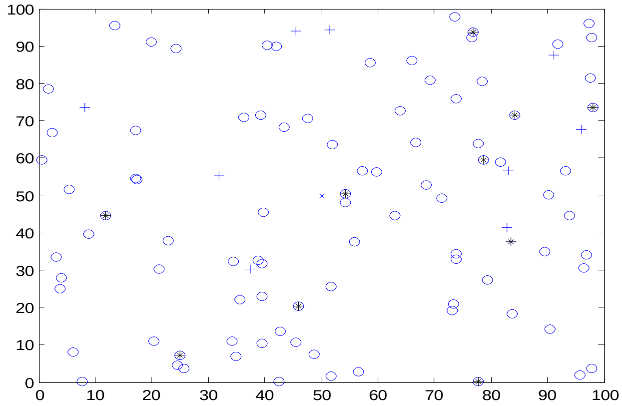

Fig.2. Random Deployment of Sensor nodes

*2. Head Election:* In the head election process,depending on the residual energy the node itself declares as a cluster head by broadcasting a Head Message to all the nodes with the optimal cluster size. The HEAD message contains the sender location and its residual energy.

*3.cluster formation:* After the head election period, the cluster formation take place. For such a cluster formation, we do not control the number of cluster members, but only control the cluster size.For the better formation of cluster the voronoi concept is used.Furthermore, due to the use of the closest CH selection, Voronoi-shaped clusters are formed around cluster heads.

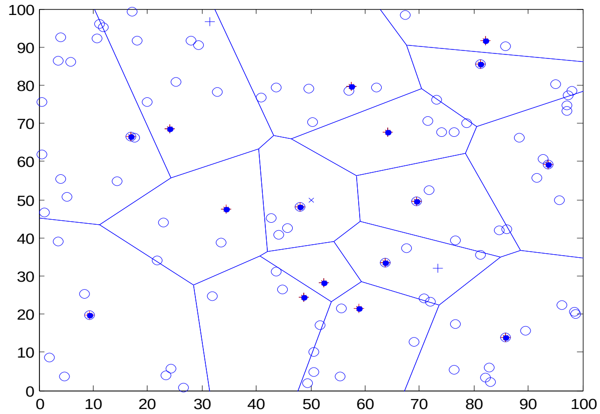

Fig.3 Cluster formation with Voronoi Field

*4. Intra cluster Routing:* The phase of intra-cluster routing is not performed in the single-hop scenario where all CMs transmit their data packets directly to their CH. In the multi-hop scenario,we present the following shortest-path routing scheme.Through the shortest path the CH sends the data to the base station.

*5. Data Communication:* In the data communication phase, only those active CMs and CHs generate and transmit sensing data, and all CHs also aggregate data. We assume that its length is much longer than the length of those preparation phases, and the energy consumption for message overhead is much less than producing and transmitting data packets in one round.

## IV. SIMULATION RESULTS

In this section, we use a customized simulator written in MATLAB to evaluate the performance of GERP. We first simulate the GERP protocol .Some simulation Parameters are as shown below:

Table I

| Parameter | Value |
|---|---|
| $e_s$ (sensing energy rate) | 5nJ/bit |
| $e_a$ (aggregation energy rate) | 5nJ/bit |
| $e_r$ (rx electronic energy rate) | 5nJ/bit |
| $e_e$ (tx electronic energy rate ) | 50nJ/bit |
| $\epsilon_{fs}$ (tx amplifier energy rate) | 150pJ/bit/m$^2$ |
| $\epsilon_{mp}$ (tx amplifier energy rate) | 0.1fJ/bit/m$^4$ |

By using the GERP, We can efficiently used the sensor nodes to transfer the information. Here ,we compare the the result of GERP with the LEACH(Low energy Adaptive Clustering Hierarchy) and GEERP(Grid Based Energy Efficient Routing Protocol).

 

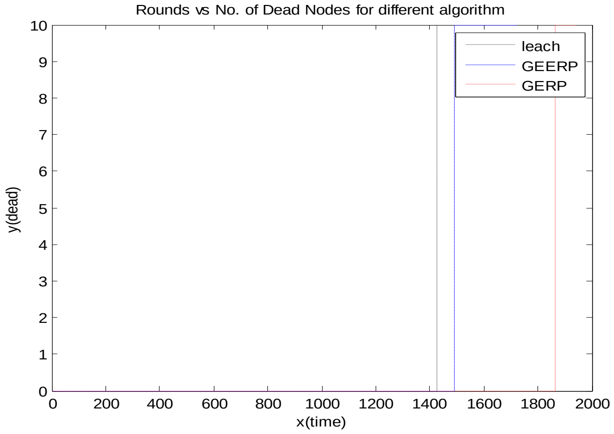


Fig.4. Rounds Vs No.of Dead nodes

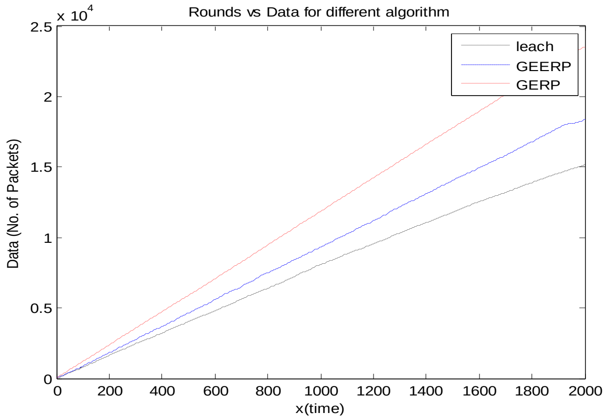


Fig.5 Rounds Vs Data for different algorithm

In LEACH the number of nodes dead after the 1400 rounds whereas in GERP the numbers of nodes dead after the 1800 rounds**.** We conduct simulations for a sensor network with 100 nodes randomly and uniformly deployed in a 100 × 100 m2 field. We use the given parameter setting in Table 1. The simulation results are averaged over 2 different network deployments. Fig 4and Fig 5 shows the number of dead nodes and data for the different algorithm.

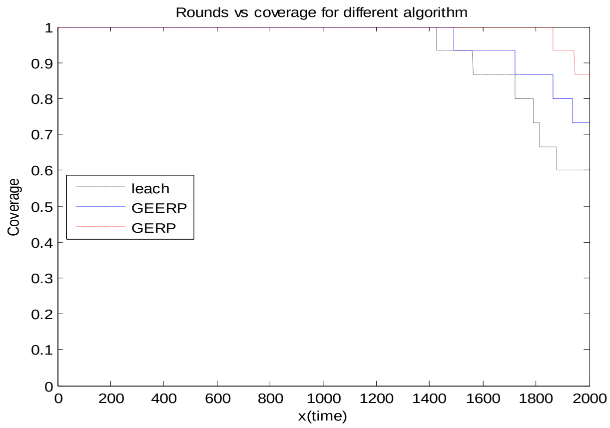


Fig.6. Rounds Vs. Coverage Ratio

Simulation results are provided in Fig.6 to compare the number of alive nodes, the coverage ratio,.It can be observed that in this scenario, the proposed GERP also outperforms the LEACH and GEERP algorithms in terms of improved network coverage lifetime.

## V. CONCLUSION REMARKS

This paper studies the problem of Coverage area and network lifetime,where the challenges include how to decide the most efficient cluster size and how to select cluster heads and active nodes. The proposed GERP uses the concept of voronoi diagram based approach in WSNs to provide a way of dividing an irregular geographical area into a number of regular regions. Our simulation results validate our computation, and show the improvement of network coverage lifetime. In our future work, we intend to study more complicated scenarios, like multi-hop transmissions between cluster heads and sink, heterogeneous sensor networks consisting nodes of different capabilities, and other non-disk sensor coverage models.

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