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Geometry Based Efficient Routing Protocol In Wireless Sensor Networks

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Abstract: ***Wireless Sensor Network (WSN) has gained tremendous research attention recently due to their extensive applications. As sensor nodes being battery operated, many researchers have made attempts to prolong the lifespan of the WSN by reducing the-per node energy consumption and efficiently utilizing the sensor nodes. Since the sensors operate on battery of limited power, it is a great challenging aim to design an energy efficient routing protocol, which can minimize the delay while offering high-energy efficiency and long span of network lifetime. This is the survey on different 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. In this regions, we deployed sensor nodes, among all these nodes CH(cluster head) is selected based on residual energy level of sensor nodes in a cluster. Then fused data of CH will be transmitted to sink node through multihop routing.***

Keywords: Wireless Sensor Network,energy efficiency,Routing Protocol,Clustering

1. Introduction

Wireless Sensor Networks (WSNs) consist of small in size sensor nodes, which form an ad-hoc distributed sensing and and data propagation network to collect the context information on the physical environment. WSN is widely used to collect reliable and accurate information in the distance and hazardous environments, and can be used in National Defense, Military Affairs, Industrial Control, Environmental Monitor, Traffic Management, Medical Care, and Smart Home etc. [2] A WSN consists of a large number of sensor nodes measuring parameters such as temperature, pressure etc. in a local area and interconnected through wireless links with the aim of relaying the sensor measurements to a central data sink. The main applications of sensor network is to periodically gather data from a remote terrain where each node continually senses the environment and sends back the data to the Base Station(BS) for further analysis, which is usually located considerably far from the target area.[3]. However these wireless sensors have several constraints such as restricted sensing and communication range as well as limited battery capacity.These limitations bring issues such as coverage,connectivity,network lifetime,scheduling and data aggregation. Basically WSNs having a two major problem Limited Battary Power and Coverage. Coverage problem is regarding how to ensure that each of the points in the region to be monitored is covered by the sensor.The another restrictive factor in the network lifetime of wireless sensor network is limited energy resource of the deployed sensor nodes. Therefore energy efficiency plyas a significant role in the network lifetime. So.we described a novel energy efficient and lifetime increased proposed protocol.

This paper studies the works done in solving the coverage problem as well as limited battery power. This paper involves the two main features Voronoi concept for solving the coverage problem and clustering and multihop routing for efficient battery power. Clustering schemes are tupically utilized by hierarchical protocols.The benefits of clustering protocols include scalable, energy efficient route discovery and easy to manage.One of the most popular hierarchical routing protocol in WSN is LEACH[8].Leach,TEEN[4] assumes that the sensor networks are homogeneous networks.Leach is the first clustering algorithm,balances,energy consuming in each node by selecting cluster heads periodically.

This paper is organized as follows: review of previous work in Section 2, In Section 3, we describe voronoi concept and Routing algorithm in detail.Section 4 concludes the paper.

2. RELATED WORK AND MOTIVATION

For conserving energy, many energy-efficient routing protocols have been proposed like LEACH[10], DEEC [0],TEEN[0] .LEACH is a clustering based protocol that utilizes randomized rotation of cluster heads to evenly distribute the energy load among the sensor in the network[7].The operation of LEACH can be divided into rounds.(a) Set-up Phase- each node decides with predefined probability whether or not become a cluster head.Although for asensor node which has been selected as a cluster head once then there is no chance to become a cluster head again in a working cycle.(b)Steady-state phase sensor nodes transfer data to the sink nodeand cluster head is maintained. Moreover LEACH consumes a lot of energy resources because it considers only on the spatial density of the sensor network not the heterogeneity of nodes in terms of their initial energy.

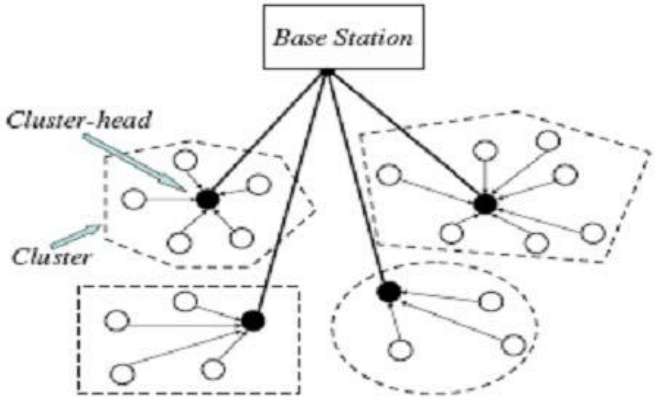

Fig.1.LEACH Protocol

In [8], Proposed HADCC executes in new advance network topology, in which BS is positioned in center of the network area and whole network area is logically divided into two levels; In first level, HADCC's algorithm performs centralized cluster formation and in second level,clustering algorithms shows distributed properties for cluster head selection. Working mechanism of HADCC path planning algorithm is divided into time-based iterations. Moreover each iteration is divided into multiple sub-iterations called; Cluster-Head Selection Phases (CHSP), Member Association Phase (MAP) and Data Communication Phase (DCP). Number of iterations can assist to analytical analyze the overall network life time provided by HADCC algorithm. In order to enhance energy efficiency of the network in large network multi hopping and hierarchical model can be implemented.

BHCDA algorithm[9]works for improving bandwidth utilization in terms of packet delivery ratio and throughput as metric of computation with decrease in energy consumption.It works in three phases,In initial phase, randomly distributed heterogeneous nodes are organized into the number of clusters.In the second phase each CH is responsible for aggregation of data packets generated by cluster members with variable rate. In the third phase individual node can perform inter cluster aggregation.

In GPCA[6], a Virtual Header (VH) transfers data to the nearest VH, and the nearest VH forwards the data to sink node. In this way, the energy dissipation of the entire network is reduced because of the transmitting distance between VHs and the sink that is greatly shortened. In this algorithm a large number of nodes are self-organized by a distributed cluster formation technique. Moreover, a randomized technique is used to rotate the local cluster-heads base on power label in order to evenly distribute the energy load among the sensors in the network. GPCA uses geographical position to enable scalability and robustness for dynamic networks.The proposed GPCA does not require any global knowledge of the network in the election round, the level of long hop communication between nodes is limited.

Yamuna Devi C R, S H Manjula, K R Venugopal, L M Patnaik proposed EESOR[0] to reduce the end-to-end delay, routing overhead and to increase the throughput and lifetime of a multi-hop wireless sensor network. The size of set of forwarder nodes of the source node is reduced by imposing a condition that, the neighbour nodes of the source node nearer to the destination are selected to be included in the set of forwarder nodes. These nodes in the forwarder list are sorted according to the descending order of their distance from the destination node. Opportunistic routing is applied for the flow of acknowledgment packet from target to source, to balance the energy consumption among thenodes in the network.

3. Voronoi Concept And Routing Algorithm

Wireless sensors have several constraints such as restricted sensing and communication range as well as limited battery capacity Coverage problem in WSN basically is caused by three main easons; not enough sensors to cover the whole ROI,limited sensing range and random deployment. However random deployment could cause some of the sensors being deployed too close to each other while others are too far apart.In both situations coverage problem will arise.To solve the coverage problem there three main strategies;Force based,Grid based and Computational geometry based. Force based methods use attraction and repulsion forces to determine the optimal position of the sensors while grid based methods use grid points for the same objective. As for the computational geometry approach, Voronoi diagram and Delaunay triangulation are commonly used in WSN coverage optimization algorithm. In this project we consider irregular shaped geographical area for wireless sensor node deployment. We also propose to make use of a voronoi diagram based approach to divide the irregular target area into regular regions. We have simulated the node deployment strategies using the simulation tools(MATLAB).

3.1 Forced based Deployment

Force based deployment strategies rely on the sensors mobility, using virtual repulsive and attractive forces the sensors are force to move away or towards each other so that full coverage is achieved. The sensors will keep moving until equilibrium state is achieved; where repulsive and attractive forces are equal thus they end up canceling each other.

3.2 Grid Based

The coverage is estimated as ratio of grid points covered to total number of grid points in the ROI. The cost of this method is determined by number of grid points; $n \times m$ and amount of sensors deployed. There are three types of grids commonly used in networking; triangular lattice, square grid and hexagonal grid. Triangular lattice has the smallest overlapping area hence this grid requires the least number of sensors, square grid provide fairly good performance for any parameters while hexagonal grid is the worst among all since it has the biggest overlapping area.

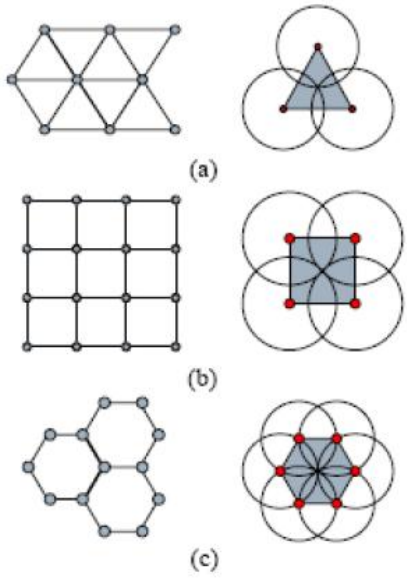

Figure 2: Types of Grid (a) Triangular Lattice (b) Square Grid (c) Hexagonal Grid

3.3 Computational Geometry Based

Computational Geometry is frequently used in WSN coverage optimization, the most commonly used Computational Geometry approach are Voronoi diagram and Delaunay triangulation.voronoi diagram partitions the given area into a number of Voronoi cells in such way that there exists only one sensor in each cell. Voronoi diagram can act as fundamental sampling method for WSN coverage, with sensor acting as sites. Voronoi diagram is employed to identify the natural number of clusters from the input data points Delaunay triangulation is the dual of Voronoi diagram . A Delaunay triangle is formed by three sites provided if and only if the sites' circumcircle does not contain other sites.The centre point of the circle is a Voronoi vertex with equal distance from each of the three sites. Voronoi diagram in enhancing WSN coverage using sensors' mobility. The protocols suggested start with initial random deployment of the sensors.

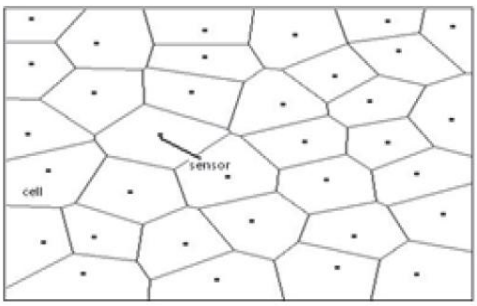

Figure 3:Voronoi diagram of WSN

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. 4a). Second, sensor s1 determines the intersection of L12 and L13 after discovering neighbouring
node s3 (see Fig. 4b). 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. 4c 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. 4e).

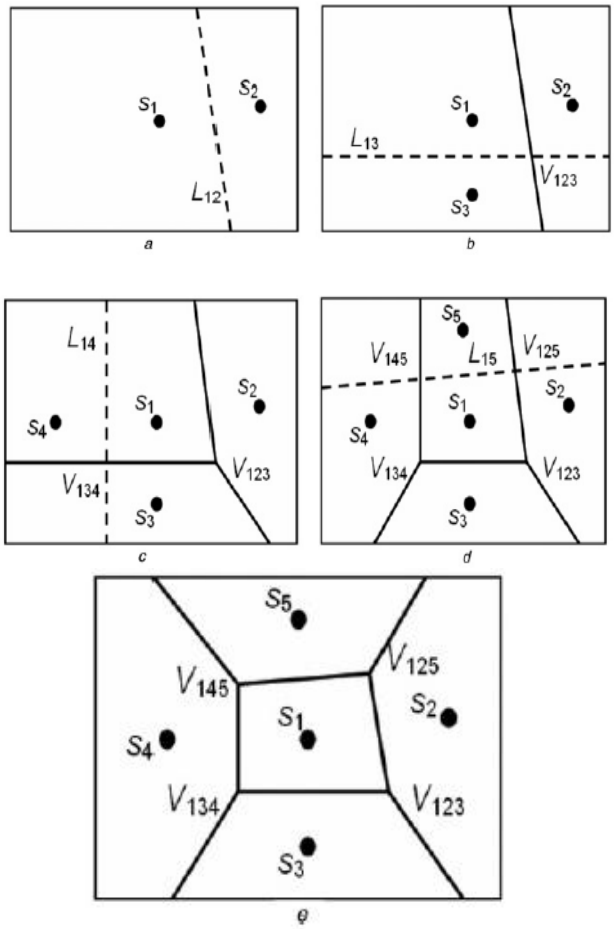

Figure 4:Process of voronoi field

With the help of Voronoi diagram for irregular shaped geographical area we get different segments or the regions.In this regions we formed a clusters. An arrangement of sensor nodes into different virtual groups is known as Clustering. Each cluster has one cluster head and it is responsible for data aggregation. Instead of direct communication with the sink, all the member nodes in one cluster send data to the cluster head. Direct routing between CHs and sink nodes may cause high energy consumption and concentrated energy consumption. Each cluster rotates its CH as the rounds by residual energy of each sensor node. The CH selection algorithm can reduce the energy consumption. CH transmits packets to sink node through multi-hop routing, which is determined by minimum weight. The multi-hop routing in clusters can balance the energy consumption. It is significant to develop routing algorithms which adapts energy-saving and coverage-preserving scheme to balance energy consumption and keep high network coverage in WSNs.

4. Conclusion

It is significant to develop routing algorithms which adapts energy-saving and coverage-preserving scheme to balance energy consumption and keep high network coverage in WSNs. Geographical routing protocol emphasis on network topology, election of CH and optimal routing, all of which can be able to avoid uneven distribution of CHs, low network coverage, and uneven energy consumption.In the first part we 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. In this regions, we deployed sensor nodes, among all these nodes CH(cluster head) is selected based onresidual energy level of sensor nodes in a cluster. Then fused data of CH will be transmitted to sink node through multihop routing.

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