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Improved Chain Based Routing Protocol for WSN

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Abstact: **A WSN is a specialized wireless network made up of a large number of sensors and at least one base station. Recent technological advances in communications and computation have enabled the development of low-cost, low-power,small in size, and multifunctional sensor nodes in a Wireless Sensor Network (WSN). Since the radio transmission and reception consumes a lot of energy, one of the important issues in wireless sensor network is the inherent limited battery power within network sensor nodes. In order to maximize the lifetime of sensor nodes, it is preferable to distribute the energy dissipated throughout the wireless sensor network .Routing protocols are designed to use energy of the sensor nodes efficiently. In our proposed work we are changing the idea related to the data gathering and transmission protocol Chiron. The main goal of our research is reduce of energy consumption and improve the lifetime of network as chain leader belonging to the certain covering angle will only transmits the gathered data to the another chain leader of the same covering angle and then we send the data of the another covering angle in sequential manner. By this method we found that energy consmption is reduced and lifetime is improved significantly. We take the 100m*100 m area and 100 nodes for 3000 iterations for simulation.**

Keywords: WSN, Routing Protocols, Energy Consumption, Sensor Node ,Life Time, Base Station, chain based routing.

I. INTRODUCTION

A WSN is a specialized wireless network made up of a large number of sensors and at least one base station. The sensor nodes are small devices that consists of four basic components 1) sensing subsystem , 2) processing subsystem, 3) wireless communication subsystem 4) energy supply subsystem[1]. The sensor nodes have limited battery power, communication range and memory etc. In most cases, the sensors forming these networks are deployed randomly and left unattended to and are expected to perform their transmission properly and efficiently. Sensor networks are also energy constrained since the individual sensors are extremely energy-constrained .Therefore the lifetime of a WSN is limited .

A real and appropriate solution for this problem is to implement routing protocols that perform efficiently and utilizing the less amount of energy as possible for the communication among nodes. Sensor devices in WSNs monitor the same event and report on them to the base station. Sensor networks need protocols, which are specific, data centric, capable of aggregating data and optimizing energy consumption . Sensor nodes deployed in a specified area monitors environmental conditions such as temperature, air pressure, humidity, light, motion or vibration, and so on. The sensor nodes are usually programmed to monitor or collect data from surrounding environment and pass the information to the base station for remote user access through various communication technologies.

The features of wireless sensor networks [2]are as depicted below.

Varying network size: The size of a sensor network can vary from one to thousands of nodes.

Low cost: For the deployment of sensor nodes in large numbers, a sensor node should be inexpensive.

Long lifetime network: An important characteristic of a sensor network is to design and implement efficient protocols so that the network can last as long as possible.

Self-organization: Sensor nodes should be able to form a network automatically without any external configuration.

Query and re-tasking: The user should be able to query for special events in a specific area, or remove obsolete tasks from specific sensors and assign them with new tasks. This saves a lot of energy when the tasks change frequently.

Cooperation/Data aggregation: Sensor nodes should be able to work together and aggregate their data in a meaningful way. This could improve the network efficiency.

Application awareness: A sensor network is not a general purpose network. It only serves specific applications.

Data centric: Data collected by sensor nodes in an area may overlap, which may consume significant energy. To prevent this, a route should be found in a way that allows in-network consolidation of redundant data.

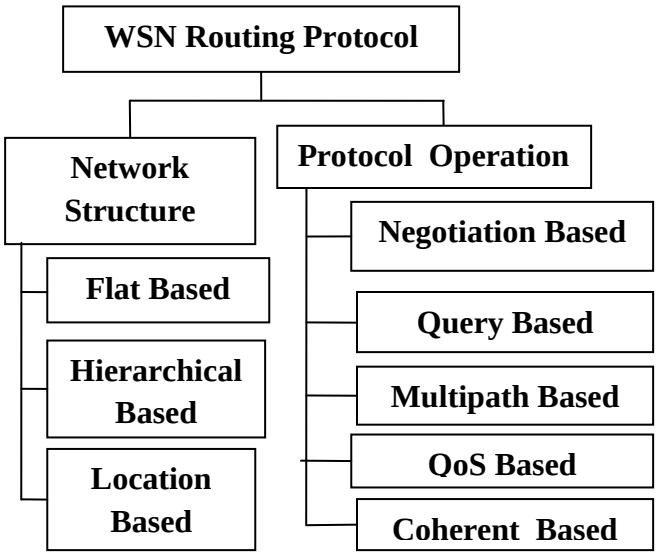

Fig.1 Routing Protocols in WSN

Various Routing Protocols in WSN are shown in the Fig.1 .Routing protocols can be network structure based and protocol operation based.

II. RELATED WORK

In general, three strategies are considered for the design of data aggregation techniques in WSNs. They are clusterbased [3], tree-based [4], and chain-based [8]. In this paper, only cluster-based and chain-based routing protocols has been reviewed.

A. LEACH

It is Low Energy Adaptive Clustering Hierarchy (LEACH) protocol. It is one of the most popular hierarchical routing algorithms for sensor networks . LEACH, a clustering-based routing protocol that minimizes global energy usage by distributing the load to all the nodes at different points in time. LEACH outperforms static clustering algorithms by requiring nodes to volunteer to be high energy cluster-heads and adapting the corresponding clusters based on the nodes that choose to be cluster-heads at a given time. At different times, each node has the burden of acquiring data from the nodes in the cluster, fusing the data to obtain an aggregate signal, and transmitting this aggregate signal to the base station.LEACH is completely distributed, requiring no control information from the base station, and the nodes do not require knowledge of the global network in order for LEACH to operate.[3] Distributing the energy among the nodes in the network is effective in reducing energy dissipation from a global perspective and enhancing system lifetime.

B. PEGASIS

Power Efficient Gathering in Sensor Information Systems (PEGASIS) protocol is an improved version of LEACH. Instead of forming clusters, it is based on forming chains of sensor nodes. One node is responsible for routing the aggregated data to the sink. Each node aggregates the collected data with its own data, and then passes the aggregated data to the next ring. The difference from LEACH is to employ multi hop transmission and selecting only one node to transmit to the sink or base station. Since the overhead caused by dynamic cluster formation is eliminated, multi hop transmission and data aggregation is employed,PEGASIS outperforms the LEACH[5]. However excessive delay is introduced for distant nodes, especially for large networks and single leader can be a bottleneck.

C. HEED

Hybrid Energy Efficient Distributed clustering Protocol (HEED) protocol extends the basic scheme of LEACH by using residual energy as primary parameter and network topology features (e.g. node degree, distances to neighbors) are only used as secondary parameters to break tie between candidate cluster heads, as a metric for cluster selection to achieve power balancing. The clustering process is divided into a number of iterations, and in each iterations, nodes which are not covered by any cluster head double their probability of becoming a cluster head. Since these energy-efficient clustering protocols enable every node to independently and probabilistically decide on its role in the clustered network, they cannot guarantee optimal elected set of cluster heads[6].

D. EPEGASIS

A variation of PEGASIS routing scheme, termed as Enhanced PEGASIS [7] (we abbreviate it as EPEGASIS later in this paper). In their method, the sensing area, centered at the BS, is circularized into several concentric cluster levels. For

each cluster level, based on the greedy algorithm of PEGASIS, a node chain is constructed. In data transmission, the common nodes also conduct a similar way as the PEGASIS to transfer their sensing data to its chain leader. After that, from the highest (farthest) cluster level to the lowest (near to the BS), a multi-hop and leader-by-leader data propagation task will be followed. The EPEGASIS although has considered the location of the BS to slightly improve the redundant transmission path and the network lifetime, there are still some problems with that scheme. 1) For large sensing areas, the node chain in each concentric cluster would still become lengthy, and thus result in a longer transmission delay. 2) Since the leader node election strategy is same as that in PEGASIS (by taking turns),it did not consider the node's residual energy. As a node with the least residual energy is elected to act as the leader, the network lifetime would be significantly affected. 3) While the distribution of sensor nodes is not even, the transmission distance between two chain-leaders in different cluster levels might be lengthy, this would consume more energy.

E. COSEN

COSEN(Chain Oriented Sensor Network) operates in two phases - chain formation phase followed by data transmission phase. In the chain formation phase, chains of different levels are formed and in data transmission phase, information is transmitted along with the designated paths. One higher level chain and several lower level chains are formed with the deployed sensors. In each chain, one node is elected as a leader. In every kind of chains, the chain-leader is elected based on some criteria or measures. Lower level leader nodes are responsible to collect information from lower level chains and send the information towards higher level leader[8]. Higher level leader sends the information to BS.

III. CHIRON PROTOCOL

For improving the energy consumption and data transfer rate is aWSN an energy efficient hierarchical chain-based routing protocol, termed as CHIRON is discussed here. The design philosophy is described as follows.

A. Network model and assumptions

Without loss of generality, in our research, we also consider a WSN of *n* energy-constrained sensor nodes, which are randomly deployed over a sensing field. The BS is located at a corner of the sensing area, and equipped with a directional antenna and unlimited power. As a result, the BS can adaptively adjust its transmission power level and antenna direction to send control packets to all nodes in the WSN. Besides, for easy discussion, we define some notations as follows:

- R: the transmission range of the BS. For simplicity, we use distinct integers (1 …n) to represent various ranges.
- θ: the beam width (covering angle) of the directional antenna. Also, similar to the definition of *R*, different integers (1….n) are used to indicate distinct angles.
- $G_{\theta,R}$: the group id. Theoretically, by changing different values of $\theta$and *R*, the sensing area can be divided into n*n groups. Those are $G_{1,1}$ …,$G_{1,2}$,…, $G_{1,n}$,….,$G_{n,1}$,…, $G_{n,n}$.
- n_i: the node i; the node set N={n_1, n_2, n_3, ..., n_i}, where 1≤i≤ |N|.
- $C_{x,y}$: the id of a chain which was formed in group *Gx*,*y*. the chain set *C*={ $C_{1,1}$, $C_{1,2}$,….}.
- $l_{x,y}$: the leader node id of chain $C_{x,y}$. The leader set *L*={$l_{1,1}$, $l_{1,2}$,…….}.
- neighbor(n_i): the neighboring nodes of n_i . The neighboring nodes mean the nodes which are locating in the transmission range of a specific node.
- Res(n_i): the residual energy of node n_i.
- dis(x, y): the distance between nodes x and y. The BS can be deemed as a special sensor node.

B. The CHIRON Protocol

The operation of CHIRON protocol consists of four phases: 1) Group Construction Phase. 2) Chain Formation Phase. 3) Leader Node Election Phase. And 4) Data Collection and Transmission Phase.

1) Group Construction phase

The main purpose of this phase is ready to divide the sensing field into a number of smaller areas so that the CHIRON can create multiple shorter chains to reduce the data propagation delay and redundant transmission path in later phases. Instead of using concentric clusters as EPEGASIS scheme does, the CHIRON adopts the technique of BeamStar [9] to organize its groups. After the sensor nodes are scattered, the BS gradually sweeps the whole sensing area, by successively changing different transmission power levels and antenna directions, to send control information (including the values of *R* and) to all nodes. After all nodes receiving such control packets, they can easily determine which group they are respectively belonging to. In addition, by the received signal strength indication (RSSI)[10], every node can also figure out the value of dis(ni, BS). A grouping example with R=1..3 and =1..2 is shown in Fig.2.

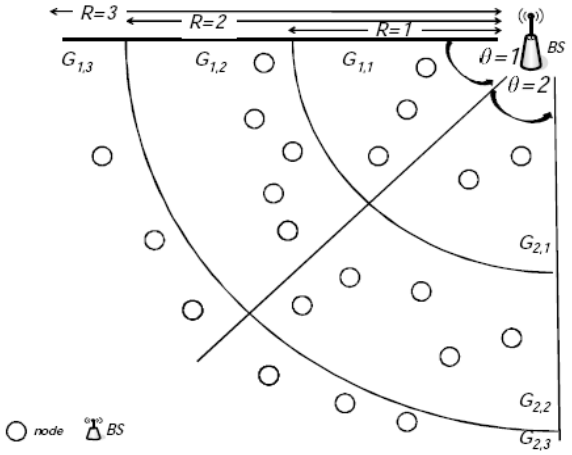

Fig. 2 Grouping example with R=1.3and θ=1.2

2) Chain Formation phase

In this phase, the nodes within each group Gx,y will be linked together to form a chain $C_{x,y}$, respectively. The chain formation process is same as that in PEGASIS scheme. For each group *Gx,y*, the node n_i with the maximum value of dis(n_i,BS) (that is farthest away from the BS) is initiated to create the group chain. By using a greedy algorithm, the nearest node (to n_i) of neighbor(n_i) will be chosen to link the node n_i, and become as the newly initiate node in next linking step. The process is repeated until all nodes are put together, and thus finally a group chain is C_{xy} formed as shown in Fig.3.

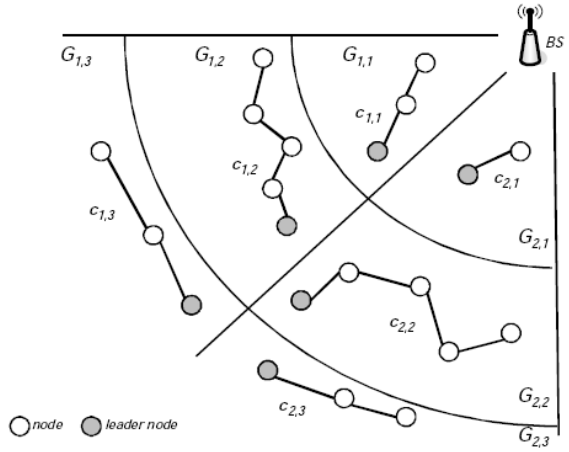

Fig.3 Chain formation in chiron

3) Leader Node election phase

For data transmission, a leader node in each group chain must be selected for collecting and forwarding the aggregated data to the BS. Unlike the PEGASIS and EPEGASIS schemes,in which the leader in each chain is elected in a round-robin manner, CHIRON chooses the chain leader ($l_{x,y}$) based on the maximum value Res(n_i) of group nodes. Initially, in each group,the node farthest away from the BS is assigned to be the group chain leader. After that, for each data transmission round, the node with the maximum residual energy will be elected. The residual power information of each node n_i can be piggybacked with the fused data to the chain leader $l_{x,y}$ along the chain , $C_{x,y}$so that the chain leader can determine which node will be the new leader for next transmission round.

4) Data Collection and Transmission phase

After completed the previous three phases, the data collection and transmission phase begins. The data transmission procedure in CHIRON is similar to that in PEGASIS scheme. Firstly, the normal nodes in each group $G_{x,y}$, transmit their collected data along the $c_{x,y}$, by passing through their nearest nodes, to the chain leader $l_{x,y}$. And then, starting from the farthest groups, the chain leaders collaboratively relay their aggregated sensing information to the BS, in a multi-hop, leader-by-leader transmission manner. In order to avoid a longer transmission distance incurred between two chainleaders, and thus result in a great amount of energy dissipation, a neighboring leader of $l_{x,y}$ with the following qualifications would be elected as relaying node: 1) it is to the BS than $l_{x,y}$. 2) the distance is minimal.

IV. MODIFIED CHIRON SCHEME

Chiron is used to split the sensing field into a number of smaller areas, so that it can create multiple shorter chains to reduce the data transmission delay and redundant path, and therefore effectively improve the lifetime of the network. In CHIRON routing is done on the basis of angles with changes in the path. Due to this sensing time and power dissipation increases hence the CHIRON has not exact output when we compare to the real applications. In proposed schemes communication, routing is done between clusterhead (CH) to cluster head (CH) directly in straight line and network is dividing into two parts, so only two sensor elements are present between two clusterheads (CHs). Hence we have two straight paths for routing. Since the number of sensor elements are reduced so sensing time and power dissipation are reduced hence the improvement in the lifetime of the network is possible.

V. SIMULATION AND RESULT

For evaluation the performance of our proposed CHIRON protocol, in this section, we use a simulation tool MATLAB [11] to conduct several experiments.

A. Simulation Parameters

In our simulations, we consider three different sizes of sensing area: 100 m*100 m with 100 randomly deployed sensor nodes. The BS is located on the corner of sensing field. Every sensor node is initially equipped with 0.5 joules power. We define the average delay as the average required hops, and the redundant transmission path as the number of detour hops, for one node transmits its sensing data to the BS, respectively. We also define the simulation round as a duration time in which all sensor nodes sent a 2000-bit packet to the BS. For each simulation scenario, the results are drawn by the average value of 10 runs.

B. Simulation Results

In Chiron routing is done on the basis of angles with change in the path. But in our case the routing starts from chain leader to chain leader with no changes in the path. So data has to travel with less number of hops so consumption of energy decreases and number of died nodes starts decreasing hence lifetime of the networks improves significantly. As shown in Fig.4, blue line shows the energy consumption of the Chiron and red line shows the reduction in the energy consmption of the proposed protocol.Similarlly Fig.5 shows dead node rate in Chiron and modified Chiron protocol.

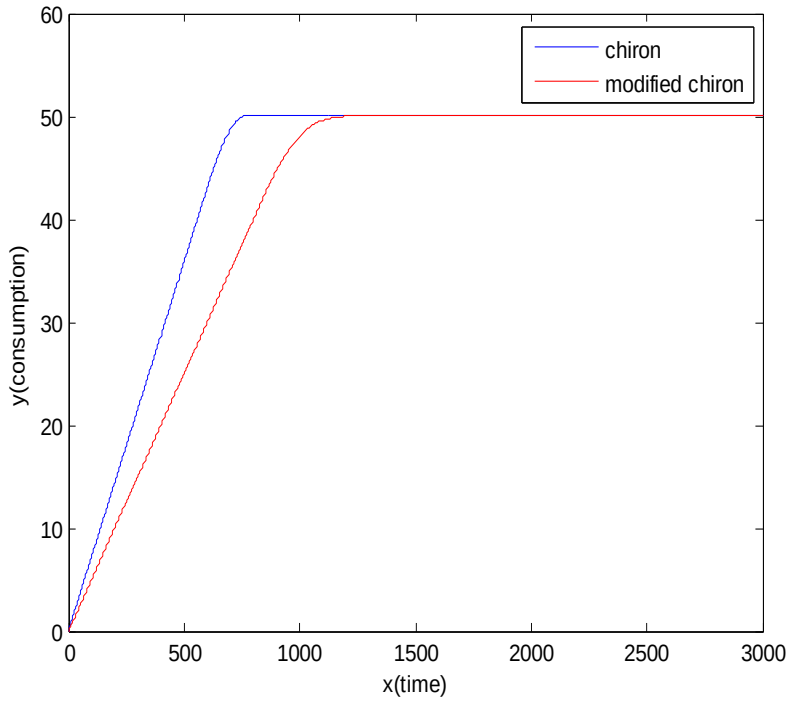

Fig.4 Results showing reduced energy consumption

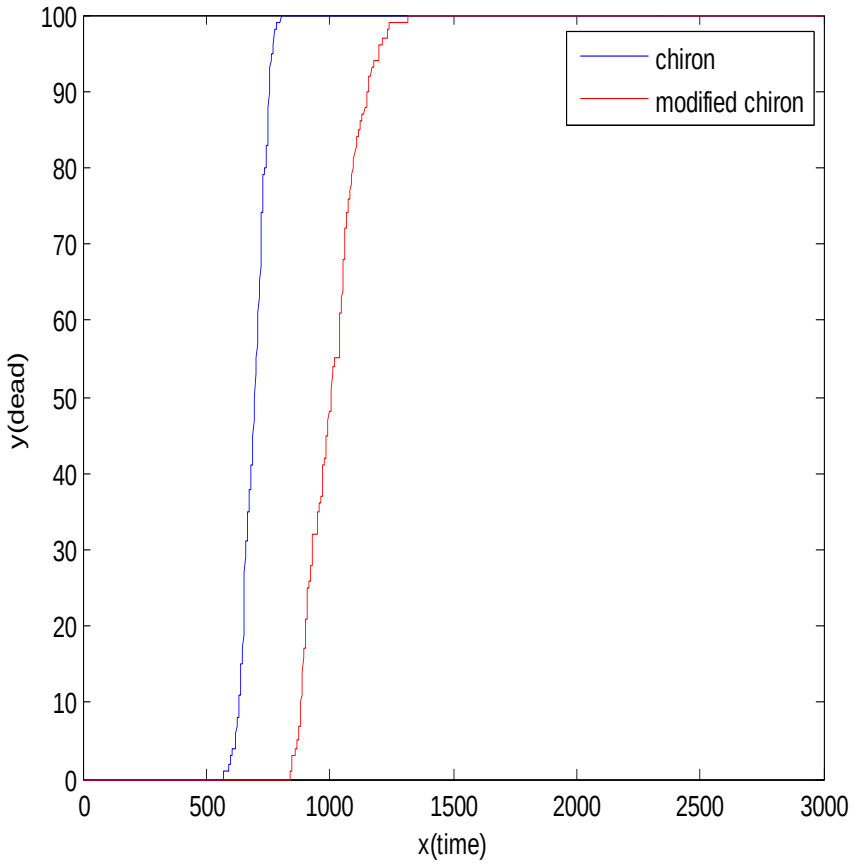

Fig.5 Improved lifetime of WSN

VI. CONCLUSION

In this paper, we discuss an energy efficient protocol for large sensor networks with power and time constraints. Energy consumption and network lifetime are the major isssues in Wireless Sensor Networks (WSN). In our approaches, we utilize the concept of Beam Star topology to divide the whole sensing field into a number of smaller areas, so that the it can create multiple shorter chains to reduce the data propagation delay and redundant transmission path, thus it significantly reduce the energy consumption and improves the network lifetime as compare to the Chiron because routing is done between chain leader to chain leader and network is divided into two parts so that the chain leader of the same covering angle will transmits the data to the next chain leader but in the same covering angle and in the sequential manner. Hence we have sequential straight path for routing. Since the number of sensor elements are reduced so sensing time and power dissipation are reduced and hence lifetime of the network is improved.

REFERENCES

[1] N.M. Elshakankiri, N. M. Moustafa and Y. H. Dakroury,"Energy Efficient Routing Protocol for Wireless Sensor Network" *IEEE InternationalConference on pp. 393–398,December 2008.*

[2] Rajashree.V.Biradar , Dr. S. R. Sawant Dr. R. R. Mudholkar ,Dr. V.C.Patil Multihop"Routing In Self-Organizing Wireless Sensor Networks" *IJCSI Interational Journal of Computer Science Issues, Vol. 8, Issue 1, January 2011.*

[3] W. R. Heinzelman, A. Chandrakasan, and H. Balakrishnan, "Energy-Efficient Communication Protocol for Wireless Microsensor Networks",
Proceedings of the 33rd Hawaii International Conference on System Sciences, 2000.

[4] S. Hussain, and O. Islam,An Energy Efficient Spanning Tree Based Multi-Hop Routing in Wireless Sensor Networks," *Proceedings of Wireless Communications and Networking Conference*, pp. 4383-4388,2007.

[5] S. Lindsey, C. S.Raghavendra, and K. M. Sivalingam, " Data Gathering Algorithms in Sensor Networks Using Energy Metrics," *IEEE*
Transactions on Parallel Distributed System, Vol. 13, Issue. 9, pp. 924-935, 2002.

[6] Ossama Younis et.al"Distributed Clustering in Ad-hoc Sensor Networks: A Hybrid, Energy-Efficient

Approach",*Proceedings of IEEE INFOCOM, Hong Kong, an extended version appeared in IEEE Transactions on MobileComputing, 2004.*

[7] S. M. Jung, Y. J. Han, and T. M. Chung, " The Concentric Clustering Scheme for Efficient Energy Consumption in the PEGASIS,
on AdvancedCommunication Technology, Vol. 1,
pp. 260-2 *Proceedings of the 9th International Conference*
65, 2007.

[8] N. Tabassum, Q. E. K. M. Mamun, and Q. Urano, " COSEN: A Chain Oriented Sensor Network for Efficient Data Collection," *Proceedings of the Global Telecommunications conference*,Vol. 6, pp. 3525-3530, 2003.

[9] S. Mao, and Y. T. Hou, " BeamStar: An Edge-Based Approach to Routing in Wireless Sensor Networks,*IEEE Transactions on Mobile Computing*,Vol. 6, Issue 11, pp. 1284-1296, 2007.

[10] Xiaoli Li, Hongchi Shi, and Yi Shang," A Sorted RSSI Quantization Based Algorithm for Sensor Network Localization" *Proceedings of the 2005 11th International Conference on Parallel and Distributed Systems (ICPADS'05)*

[11] The MathWork - MATLAB and Simulink for Technical Computer: http://www.mathworks.com

