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Energy Efficient Data Dissemination in Wireless Sensor Network

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Abstract: From the decades in wireless sensor network lot of work is done on data dissemination scheme to reduce the energy consumption in wireless sensor network. Typically wireless sensor network consist of event sink and large number of sensor node. The sensor nodes are low cost, low power and multi functional devices. Sensor node are randomly distributed over a vast field to self organize a large scale sensor network. In this paper we have proposed optimal approach which reduces the energy consumption for data dissemination in whole sensor network which is built in grid based wireless sensor network. The grid construction is done by the initiation of source which further called as sensor node if no valid grid is present and if source will initiated during in presence of valid grid then it uses the exit grid and also handle the multiple sink in sensor network which reduce the energy consumption in all manner.

Keywords: Sink, Source, Virtual Gird and sensor nodes.

I. INTRODUCTION

Wireless sensor network are the class of distributed system that are integral part of physical space. Sensor network are collection of nodes and each node is autonomous and has short range and they cooperative over a large range. Typical wireless sensor networks consist of sinks, events, and a large number of sensor nodes. The sensor nodes are low-cost, low-power, but multi-functional devices. A large number of the sensor nodes are randomly distributed over a vast field to self-organize a large-scale wireless sensor network. The sensor nodes monitor some events in surrounding environments such as heat and sound or vibration and the presence of objects etc. If a sensor node detects an event, the sensor node produces data and makes data announcement to sinks subscribing the data. The sensor node denotes a source node and this procedure is called data dissemination. The wireless sensor network consist of nodes from one to hundred or even to thousand and each sensor node has several parts like radio transceiver, microcontroller an electronic device which provide interface between sensors node and energy source and battery which is basically used for energy harvesting. The topology of wireless sensor network varies from simple to multi hop wireless mesh network. Typical wireless sensor network consist of sinks, event and source and sensor nodes are of low cost, low power and multi-functional devices which are random distributed over the vast field and also have an property of self organizing a wireless sensor network. Wireless sensor network fall in three major categories:- Periodic sensing, Event driven and Query based. In periodic sensing sensors are always sensing physical environment and continuously send measurement to the sink like in weather monitoring application. In event driven sensor are operate in a silent monitoring state and trained to notify event like in intrusion detection, target tracking or in military application. In query based the generated data reports are made available within the sensor network, and sensors react to the queries of the sink by returning the corresponding requested measurement and event.

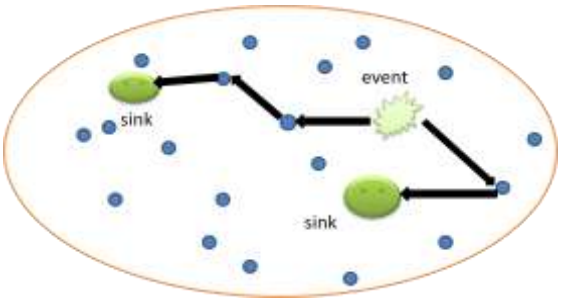

Figure 1: Data Dissemination in Wireless sensor Network

II. RELATED WORK

In wireless sensor network day by day there is lot of work is done to reduce the energy consumption of data dissemination in wireless sensor network .Various protocol is designed like Meta data, sink location dissemination, single node and set of nodes which reduces the energy consumption in much more efficient manner. Direct diffusion in wireless sensor network is scheme in which the sink nodes flooding interest message and sensor node that matched data send them to the corresponding sink node .Direct diffusion updating path even if the sink fails. The performance of directed diffusion is degrades by the mobility of sink. Two tier data dissemination scheme (TTDD) which source nodes are both location aware and stationary and source divided the grid of the cells and proactively build a grid structure throughout the sensor filed that provide efficient data delivery to multiple mobile sink. Query form the sink to source traverses two tiers: higher tier and lower tier. Higher tier is consisting of dissemination node and lower store the current location of the sink. In TTDD when event generated and sink needs a data it forwards the query with in a local area about cell size large to discover nearby dissemination nodes. In query forwarding sink specifies the maximum distance, and flooding stop when there is maximum distance away from sink when the query is forward to upstream to until it reaches to source nodes and upstream stores the location of its downward stream and then correspondingly data is send to the sink.

After that GBBD dual radio mode is exploit to form the grid across the sensor field grid is construct in the sensor field if no valid grid is present in sensor filed if the valid grid is present in the sensor filed then it goes through the exiting grid and cell size is decided on the long and short range of the dual radio transmission range and ensure the continuous delivery of measurement or data from source node to sink by handling multiplicity of sink, source and event. Grid is constructed by keeping itself as one of the crossing point and two dimensional coordinates of the sink become the start point of the grid construction. In comparison to all of these EGDD is more beneficial to consume less energy in data dissemination in wireless sensor network. In EGDD virtual grid is formed by the initiation of source if no valid grid is present there is presence of valid grid then it use the already exit grid and it handle multiple sinks in the sensor network.

III. Energy Efficient Grid Based Data Dissemination

Network Model

- Grid is constructed only when source is appearing in the sensor field and there is no existing grid.
- The sensor nodes are the stationary.
- Each sensor node is aware of its location by using GPS.
- Sensor nodes are uniformly distributed in entire sensor network.

Grid Construction

Grid construction is done by the source initiates if no valid grid is present in the sensor and if present then be use the already exiting grid. The source divide the entire field into grid of cells and each cell is an $\alpha \times \alpha$. A source itself is at crossing point of the grid they propagates data announcement to each all other crossing point called dissemination point on the grid. For particular source at location Ls =(x,y)and dissemination point are located at Lp =(Xi ,Yj) such that

$\{Xi=x+i\alpha,\ Yj=y+j\alpha;\ Ij=\pm0,\pm1,\pm2\ldots\ldots\}$

In grid construction the source node sends the calculated co-ordinates and a predefined (g) distance of the sensor node from the crossing point with GCM. The distance g is the maximum limit of tolerance in the cell size .Each node on receiving the GCM, calculates its distance from the co-ordinates of the crossing point received with GCM. If the calculated distance is less than g, then the sensor node replies to the sender dissemination node with its co-ordinates and the sender dissemination node arranges all the distance in ascending order and selects the node with the minimum distance that is the closet node from the crossing point. The GCM message is recursively propagated in the entire sensor field so that each dissemination point on the grid is served by a dissemination node. In figure 2 grid construction is done when source initiated or event occur in the sensor filed .The source send the GCM to its crossing point A,B,C and D with in predefined radius. The distance which is less than or equal to predefined distance is reply to S and other will discard. The source node store and arrange all the calculated distance in ascending order list and select the first node from the list and the source node, send the conformation message to selected node that it will be the dissemination and if this dissemination node is failed then be choose the second one from the prepared list .

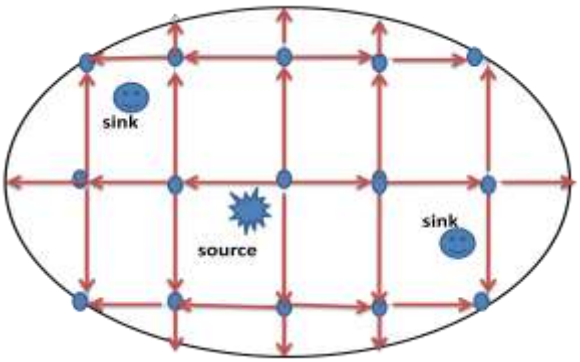

Figure 2: Grid Construction by source S

Query forwarding Scheme

When the event is occur in the wireless sensor network the source is initiate in the network and if sink want some data from the source its flooding the query in network within the local cell of the grid. The query forwarding for data dissemination in wireless sensor network for sink to source in mobile sink wireless sensor network .Each node is aware of its own location through its coordinates and as well as location of all its neighboring dissemination node .When sink wants to send or forward the query its first generate the query packet with the known location of the source .Now its forward the query to the sensor or dissemination node when a dissemination node receives the query packet ,it compares its y coordinates with y coordinates of the pervious dissemination node .If it is closer than the previous sender dissemination node then it will forward the query packet otherwise it will reject the query packet. When the Y coordinates of source node and the dissemination node is same then we will compare the x coordinates and only the node is same then we will compare the X coordinates and only the node whose X coordinates is less than that of pervious sender node will forward the query until the source dissemination node is reached.

Query Forwarding algorithm:

1. Update the query packet by including its own *(Xi, Yi)* coordinates in the packet.
2. Forward the query to all its neighboring dissemination nodes with coordinates *(Xi,Yi).*
3. While (Ys=!Yj)

   Check if neighboring is working then forward the query else, follow the different optimal path with coordinates.
4. On receiving the query packet, calculate [Ys-Yi] Yi is the Y coordinates of the receiving dissemination node.
5. If shortest path with [Ys-Yi]>[Ys-Yi],then forward the query packet, otherwise discard.
6. Then calculate [Xs-Xi] and [Xs-Xj] where Xi is the X coordinates of the sender dissemination node from where the query is received and Xj is the X coordinates of the receiving dissemination node.
7. If shortest while comparing X, Y which is having shortest distance follow diagonal method for forwarding query packet otherwise discard.
8. Check if query packet has reached successful then stop.
9. Data is sending in reverse pattern of the query sending.

Data forwarding Scheme:

The data forwarding in the network is in the reserved manner of the query sending to the source. When the query is reached to the source its generate the data according to that query and send in the reserves pattern to the sink if there is multiple sink in the network then trajectory forwarding is done and copy of data send to the all other sink.

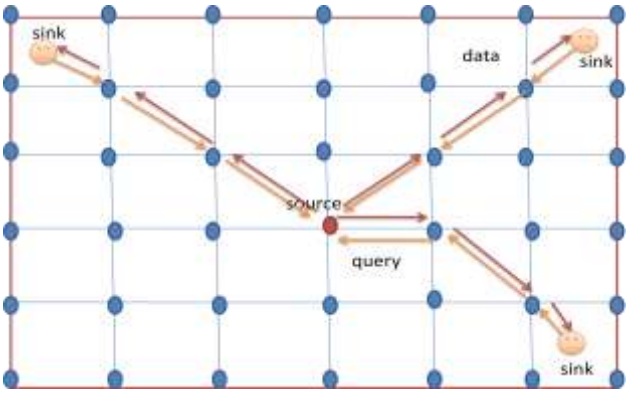

Figure 3: Query and Data forwarding in Senor Network

Performance Evaluation

In this section we evaluate the performance of our approach. Energy Efficiency is the major concern of our scheme so we have analyzed for energy only. The energy consumption is defined as the total energy consumed in the network during communication (transmitting and receiving) excluding the idle. Figure 5 and figure 5 plot the total energy consumption according to number of sinks and sources. We simulate this experiment with two cases of number difference for sinks and sources respectively.

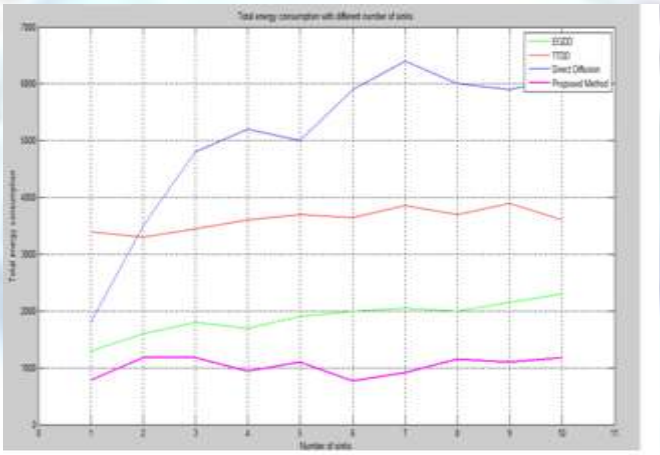

Figure 4: Total Energy Consumption according to number of Sink

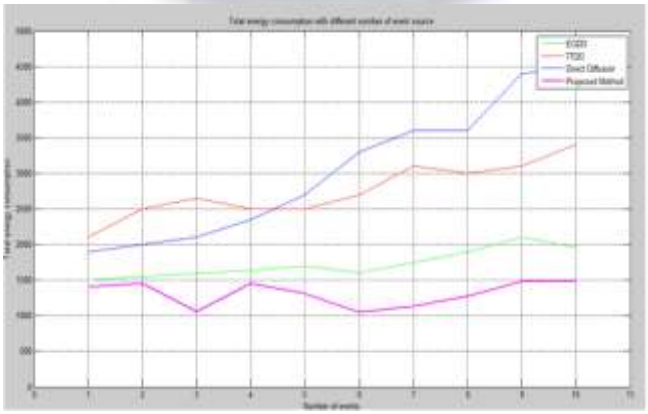

Figure 5: Total Energy Consumption according to number of event

IV. Conclusion

Our Proposed method is based on grid based data dissemination. In Decades various approaches is proposed to reduce the many problems of the data dissemination in wireless sensor network to make is efficient in cases like mobility of sink, optimal paths and handling node failure but still we can improve the data dissemination in wireless sensor network. In our proposed approach we can reduces the energy consumption in large extend our approach choose diagonal path for data dissemination and if there is no diagonal path to reach at the destination then we follows the vertical or horizontal path to reach destination which reduce lot of power consumption and also control the flooding in wireless sensor network. The proposed Method is 90 percent efficient in energy consumption.

V. Future Work

In future, we plan to extend the proposed data dissemination protocol for heterogeneous wireless sensor networks. We also plan to propose a data dissemination scheme for non-uniformly distributed WSNs where the density of node deployment varies significantly. We would also like to exploit the proposed grid based network model for devising an effective in-network data aggregation scheme and cache management scheme. Moreover, in future the proposed protocol can be analyzed experimentally using deployment of WSNs in reality.

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