International Journal of Electrical, Electronics and Computer Engineering **1**(1): 11-14(2012)

ISSN No. (Online) : 2277-2626

An Energy Efficient Approach for Highly Data-Centric Directed Diffusion in Wireless Sensor Networks

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(Recieved 15 March 2012 Accepted 2 April 2012)

ABSTRACT : Wireless Sensor Networks (WSNs) consist of large no. of tiny devices having computing power and communication capabilities with very limited energy. As we know the energy is most crucial resource in WSNs. For enhancing and increasing the life time of a network the communication protocol must be designed with scalability and lack of energy resources in mind In the present Paper we are going to improve the energy-efficiency of data-centric directed diffusion [4, 5] protocol by enhancing its interest diffusion and exploratory data messages mechanism. In interest diffusion phase sink just flood the interest in the whole network which result in energy inefficiency and reduce the battery power of sensors. For improving the flooding mechanism we divide the randomly deployed sensors of sensor network in different clusters and we propose a new algorithm for a cluster formation and cluster head selection and for exploratory data messages we reduce the number of exploratory messages on certain criteria by which we can achieve the energy efficiency.

Keywords: Data-Centric, Directed Diffusion, Energy efficiency, Network life time, Wireless Sensor networks.

I. INTRODUCTION

A sensor is a device that produces a measurable response to a change in a physical condition, such as temperature, weight etc. When this sensors densely deployed in area for cooperatively monitoring the environmental condition then it form a Sensor network or Wireless Sensor Network. This wireless sensors node work on radio media for relaying the sensing information in the network. Radio media uses the free Industrial Scientific Medical (ISM) [11] bands which provide the license-free communication. Wireless sensor network architecture consist of three things they are

1. Stimulus
2. Sensor Node(Source)
3. Sink

Stimulus: Stimulus is the event which occurred at the sensor node.

Sensor Node: Sensors are micro-electro-mechanical systems (MEMS) [3] which are Low power devices and have Data processing & Communication capabilities. Sensor node senses the event and collects the data and route the data to the sink. Sensor node gathers data locally which include temperature, humidity, motion detection, etc.

Sink: Sink is the information collection centre. All sensor nodes finally dispatch their data to the sink.

The three main constraints in the wireless sensor networks are energy, the network bandwidth and routing. All the sensor nodes are working on the low power batteries so they must consume batteries in optimized manner. And Wireless nodes have significantly lower transmission capacity in compression to the other media. In sensor network there are sheer number of nodes so we cannot use a global class full addressing which is IP addressing in the wireless sensor nodes [3]. For improving the battery life of sensors in the network, we propose a new strategy in which for improving the flooding mechanism we divide the randomly deployed sensors of sensor network in different clusters and proposing a new algorithm with cluster formation, cluster head selection and for exploratory data messages. Here, we reduce the number of exploratory messages on certain criteria by which we can achieve the energy efficiency [1, 2].

Related Work: Due to limited bandwidth and energy constraint issue recent advancement in wireless technology result in many routing protocols for wireless sensor networks. Some of them are Flooding [6], Directed Diffusion, Improved Directed Diffusion, SPIN [6] etc. Flooding has a problem like implosion which result in more processing on the node and it result in more battery power. Directed Diffusion uses the on demand data query and naming scheme for the data with attributes value pairs for the data and queries. The directed diffusion is on demand data centric data query protocol so it is not use in the application which requires the continues flow of the data [4][5]. There are three different phases of directed diffusion they are Interest propagation, Initial gradients setup, Data delivery along reinforced. Maarten proposed the D3: Data-centric Data Dissemination in Wireless Sensor Networks. In this method, he combines the advantages of data-centric routing like

SPIN, directed diffusion and energy-efficient MAC protocols such as S-MAC and T-MAC [7].

Problem associated with Directed Diffusion: In Interest propagation phase of directed diffusion the sink just flood or broadcast the interest in the whole sensor network by this it may be possible that any signal node may receive a redundant copy of a interest and it have to process it .So by this redundant interest messages and flooding the batteries of sensor network get drain out quickly by which the network life time of Wireless sensor network get decrease. So our main problem is the efficiently utilization of this energy resources of sensor during the interest diffusion phase. Secondly exploratory messages are also the main problem directed diffusion. Exploratory events are used for receiving high quality events but this protocol signaling can cause great energy consumption in the network as same as the flooding of interest messages. The interest propagation and the exploratory messages are the two main problem of directed diffusion so by improving these two factors we can enhance the network life time of Wireless sensor networks.

II. OUR PROPOSED MODEL

A. Energy efficient approach for highly data-centric directed diffusion

Working of modified Directed diffusion: Now the working of directed diffusion is start by sending a cluster state message it contain sink id (identification of sink), threshold energy value (a minimum residual energy for becoming a cluster head) threshold nodes status (a minimum number of neighbor nodes), before sending this messages the state of sensor network is ordinary state and after sending this cluster state messages whole sensor network came in cluster state [9].

Sink id	Threshed energy value	Threshold nodes status

Fig. 1.1. Cluster state message format.

After receiving this cluster state message each node run the cluster formation protocol for becoming a cluster head and after that they form a clusters.

III. CLUSTER HEAD FORMATION PROTOCOL

1. Receive cluster state message by sink.
2. On receiving the cluster state message every node check it remaining power and neighboring nodes status.
3. If the remaining or residual energy is equal or more than threshold energy value specify in cluster state message then node find its neighboring node status otherwise change its state as cluster member.
4. For calculating the neighboring nodes status every node send a hello packet to all it neighbor in its transmission range
5. On receiving this hello message every sensor makes reply and send to the originator of message.
6. By this node get status of neighbor.
7. After receiving this reply of this hello messages the node came to know about its neighboring nodes status.
8. And after this a node who have neighboring nodes status and battery power more than threshold it declare itself as a cluster head and broadcast its identity to member whose state are cluster member and form cluster.

By this clustering the energy efficiency is achieved because whenever sink want to flood's it interest it just passes this interest to the cluster head and this cluster head again send this interest to their cluster member based on routing table form by cluster head by this no node get a redundant copy of interest and their unnecessary processing is save by this we can achieve the energy efficiency [8].

By this we solve the problem of the interest diffusion of directed diffusion.

IV. REDUCTION OF EXPLORATORY EVENTS

Now the second major problem of directed diffusion is the exploratory events. Which are used for receiving high quality events but this protocol signaling can cause great energy consumption in the network as same as the flooding of interest messages. So for solving this problem we propose that we can decrease the number of exploratory data messages.

In the proposes approach we reduced the number of Exploratory messages for this when in interest propagation state suppose there is a node no 1 which receives a interest messages from node no 2, 3, 4 respectively .Now node no 1 decide to send a exploratory message . In directed diffusion the node no 1 send this exploratory message to its entire neighbor 2, 3, 4 which result in energy inefficiency. So for reducing this energy inefficiency we reduce the number of exploratory messages in this node no 1 only send the exploratory message to those node who reply first or contact him first the node no 1 believe that the node who contact first has lower path delay so it decide to send the exploratory message to this node and remaining node are use when it want more quality data and for in case of path failure [10].

So by reducing the numbers of exploratory messages we achieve the energy efficiency

V. PSEUDO CODE

Cluster formation Protocol (TE, TNC)

1. Start Broadcast the cluster state Message (set TE, TNC)
2. Receive the cluster state message by node
   - I. if Residual energy of node RE > = TE
   - II. then broadcast a hello message
   - III. else set state as a cluster member node.

3. Receive a hello packets calculate the neighboring node status
   (*a*) if TNC(n) > = TNC
   (*b*) then declare itself as a cluster head and inform the cluster member to join cluster
   (*c*) inform sink
   (*d*) else set state as a cluster member node.
4. Stop.

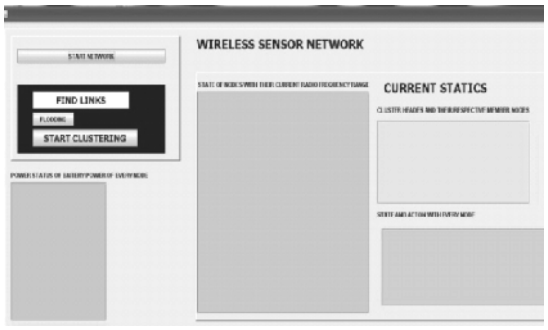
Notations

1. TE = Threshold residual/energy energy set by sink
2. TNC = Threshold (neighboring) nodes status set by sink
3. RE = Residual energy of a node.
4. TNC(n) = Threshold (neighboring) nodes status of a node

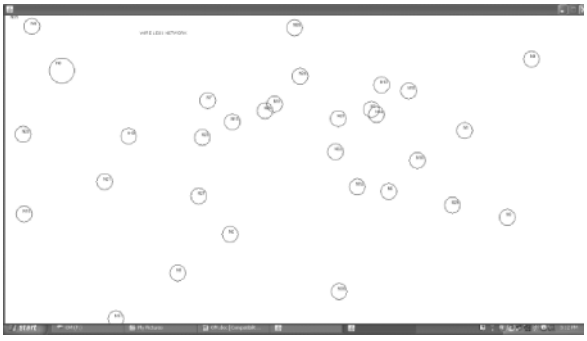
IV. IMPLEMENTATION

We implemented the concept of the above Pseudo code in java. The snapshot is presented here.

1. We develop an application in which we can deploy the sensor nodes randomly. on clicking the start network we can deploy the network

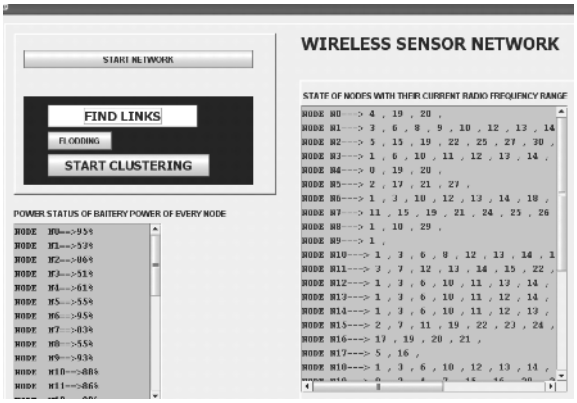


(a) Starting a network.



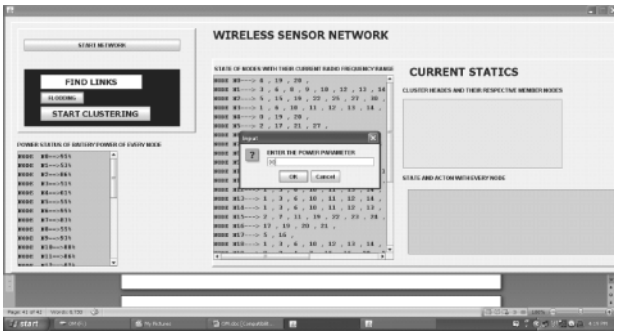
(b) Nodes deployment.

2. Now on find link tab we can find the state of nodes with their neighbors' and individual battery power of a node

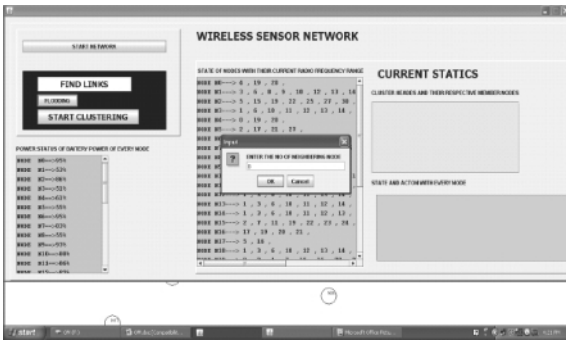


(c) Sensor showing their status

3. Now we start the flooding of cluster state message in the wireless sensor network on stating flooding sink ask for a threshold value of energy and neighbor node status for cluster head selection [12].

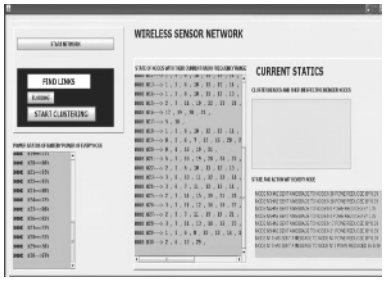


(d) Sink asking for threshold energy value



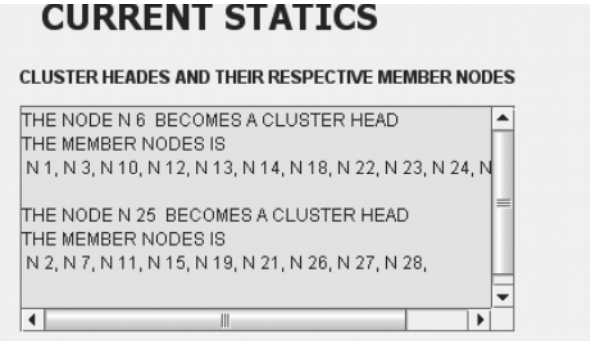
(e) Sink asking for threshold node value.

4. After the flooding the battery power of each node is decrease and after that our. Cluster state message is received by every node and now start the clustering.



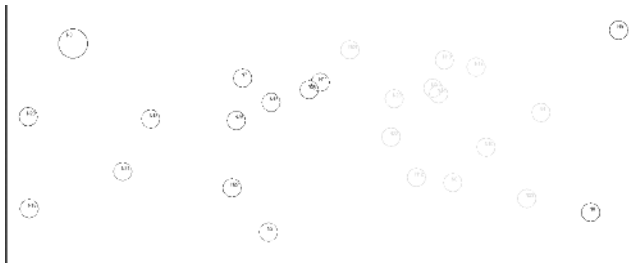
(f) Displaying the current status of battery power after flooding.

5. Now our sensor network is divided into a group of clusters having two cluster head N 6,N 25



(G) Cluster heads with their member nodes.

6. Cluster formation in network both clusters are different colors that is black and yellow



(H) Cluster Formation.

7. Final state of sensor network

(I) Final State.

VII. CONCLUSION

In our project we have analyzed the different data routing algorithm and we came to know that network life time is one of the crucial factors for every protocol the max is the network life time the protocol will be reliable. For enhancing the life time of Wireless sensor network we modify the some of the phase of directed diffusion. In diffusion interest diffusion and exploratory events are two main phase in which lots of energy is consume so for enhancing this we use cluster formation protocol and divide the network in different clusters and for exploratory data events we reduce the number of this messages. By this we can achieve the energy efficiency.

VIII. FUTURE ENHANCEMENTS

Several enhancements to our work are possible. An immediate possibility is that we can add our cluttering algorithm in directed diffusion with the help NS2 and after that it can be use a fully improved directed diffusion .We can add more factors for choosing the cluster head like in present we use the residual energy of node, neighboring node states, but we add factor like topology, Distance from base or sink station etc. We can also implement this approach for mobile sink and mobile.nodes.

REFERENCES

[1] Akyildiz I F, Su W, Sankasubramaniam Y, "Wireless Sensor Networks: A Survey," *In the Proceedings of Computer Networks*, Vol. **38**, March, 393-422(2002).

[2] Hogler K, Andrew W, "A Short Survey of Wireless Sensor Networks," *In the Proceedings of Telecommunication Networks Group*, October 2003.

[3] Akkaya K, Younis M, "A Survey on Routing Protocols for Wireless Sensor Networks," *In the Proceeding of Ad-hoc Network Elsevier, September*, pp. 325-349(2003).

[4] D. Estrin, et al., "Next century challenges: Scalable Coordination in Sensor Networks," *In the Proceedings of the 5th annual ACM/IEEE international conference on Mobile Computing and Networking* (MobiCom'99), Seattle, WA, August 1999.

[5] C. Intanagonwiwat, R. Govindan and D. Estrin, "Directed diffusion: A scalable and robust communication paradigm for sensor networks", *In the Proceedings of the 6th Annual ACM/IEEEInternational Conference on Mobile Computing and Networking* (MobiCom'00), Boston, MA, August 2000.

[6] W. Heinzelman, J. Kulik, and H. Balakrishnan, "Adaptive protocols for information dissemination in wireless sensor networks," *In the Proceedings of the 5thAnnual ACM/IEEE International Conference on Mobile Computing and Networking* (MobiCom'99), Seattle, WA, August 1999

[7] Maarten Ditzel and Koen Langendoen "D3: Data-centric Data Dissemination inWireless Sensor Networks", " *In the Proceedings of the 8th European Conference on Wireless technology*, Paris 2005.

[8] Vlado Handziski, Kopke, karl. Frank and Drytkiewicz, "Improving the Energy Efficiency of Directed Diffusion Usin Passive Clustering*", *In the Proceedings of the EWSN* 2004,LNCS 2920, pp 172-187,Springer-Verlag Berlin Heidelberg (2004).

[9] CAO Zhi-yan, JI Zhen-Zhou, HU Ming-Zeng, "An energy-aware broadcast scheme for directed diffusion in wireless sensor network", *In the Proceedings of the Journal of Communication and Computer*, Vol. (**4**): ISSN1548-7709,USA, May 2007.

[10] Farnaz Dargahi, Amir Masoud Rahmani, Sam Jabehdari, "Nodes' Credit based Directed Diffusion for wireless sensor networks," *In the Proceedings of the International journal of Grid and Distributed Computing*, 2007.

[11] Doohan NV, Chandwani M. "A perspective on highly data centric WSNs", *In Proceedings of J.P. Guna*, 6 march 2010.

[12] A. Sayyad, M.Shojafar, Z. Delkhah and A. Ahamadi, "Region Directed diffusion in Sensor Network Using Learning Automata: RDDLA" in the *Proceedings of the Journal of Advances in Computer Research*. pp 71-83, (2011).