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A Hybrid TEEN Routing Protocol for Wireless Sensor Network

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ABSTRACT:A Wireless Sensor Network (WSN) is a network of distributed sensors that can gather information from the real world. The sensor nodes can communicate with each other by using radio signals. A wireless sensor network (WSN) consists of low power, low cost, small in size and multi-functional sensor nodes. A wireless sensor node is supplied with sensing and computing devices, a radio transceiver and power components**.**The Routingprotocols in WSNs highlights on data dissemination, limited battery power and bandwidth constraints in respect to facilitate efficient working of the network, thereby increasing the network lifetime. Routing protocols in WSNs are also application specific which has guided to the development of a different variety of protocols. Depending on the underlying network structure, routing techniques it can be classified into three categories: hierarchical, data-centric and location based routing. The Reactive networks, as opposed to passive data gathering proactive networks, respond immediately to changes in the suitable parameters of interest..In this paper, we propose an energy efficient clustering protocol based on threshold energy efficient protocol which uses the threshold concept for both energy and distance. The nodes are classified into normal, advanced and super nodes based on difference in energy and distance parameters.

KEYWORDS: Wireless Sensor Networks, Routing Protocols, Energy Efficient Protocols, Network Lifetime, Hierarchical Protocols and Clustering Protocols**.**

I. INTRODUCTION

In the recent years, the use of wireless sensor networks (WSNs) is being prescribed for a number of applications. Its some examplesincludes distribution of thousands of wires and sensors overstrategic locations in a structure such as an airplane, so that the conditions can be constantly monitored both from the insideand the outside and a real-time warning can be issued when the examined structure is about to fail [1]. The Sensor networks are usually unattended and need to befault-tolerant so that the need for maintenance is minimized [2]. It is especially desirable in those applicationswhere the sensors may be embedded in the structure orare in unfriendly ground and are inaccessible for any service.The advancement in technology has made it possibleto have extremelylow and small powered devices, suppliedwith programmable computing, multiple parameter sensingand wireless communication capability [4]. Also, the cheap costof sensors makes it possible to have a network of hundredsor thousands of these wireless sensors, thereby increasingthe reliability and accuracy of data and the coverage area aswell. Also, it is necessary that the sensors be easy to deploy. TheRouting methods in WSNs have to deal with a number of design issues. Despite advancement in technology, sensor nodes in the WSNs still have limitation such as limited batterypower, bandwidth constraint, limited computing power and limited memory.It generates the need for routing protocols to be highly adaptive and resource aware.

Some of the main challenges ofrouting protocol are [6]:

(i) The Node deployment in either random or pre-determined manner.

(ii) The Data reporting method which can be a event-driven, query-driven, time-driven or a combination of all of these methods.

(iii) The Trade-off between energy consumption and accuracy of the collected data.

(iv) The Node failure tolerance of the network.

The WSNs has a design trade-off between the energy and communication overhead which manifests the nerve center of the routing techniques. In this paper, we introduce a survey of state-of-the routing art techniques in WSNs under all

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the three categories. We incorporate these routing techniques and bring out the advantages and drawbacks followed by their application domain.

II. LITERATURE REVIEW

The originating interest in wireless sensor networks and the continual advancements in microelectronics and wireless communication technologies have motivated some previous efforts for surveying the characteristics, applications and communication protocols in this technical area [1,11]. In this section we highlight the features that differentiate our survey and hint the difference in scope. The aim is to make a inclusive survey of working of protocols introduced in the network layer and possible applications of sensor networks are also mentioned. This survey is a good introduction for new readers interested in this widespread field. In this paper, we may classify the sensor networks based on the network architecture and dynamics. Such type of classification is helpful for a designer to select the suitable infrastructure for his/her application. We study the advantages and drawbacks that are existing in all the wireless sensor networks.
The sensor nodes are forced to limited resources itself, so the main aim is to design an effective and energy aware protocol in order to increase the network lifetime for specific application environment. Since the sensor nodes are not given a unified ID for identification and much unwanted data collected at destination nodes. The Routing protocols in WSNs have a common objective of efficiently using the limited resources of sensor nodes in order to increase the lifetime of the network. The Different routing methods can be acquired for different applications based on their requirements. The Applications can be time critical or requiring periodic updates, they may require correct data or long lasting, less precise network, they may also require continuous flow of data or event driven output. Routing methods can even be increased and adapted for specific application. Generally, the routing protocols in WSNs can be divided into hierarchical, location based routing, data-centric, depending on the network structure as shown in figure 1. In data-centric, all the nodes are practically equivalent and related in routing a query received from the base station to the event. In the hierarchical approach, some nodes have extra responsibilities in order to decrease the load on other nodes in the network. In the location based, the knowledge of positions of the sensor nodes is utilized to route the query from the base station to the event.
Usually, wireless sensor networks are collection of hundreds or thousands of sensor nodes. Each node consists of processing capability (one or more microcontrollers, CPUs or DSP chips) and hold several types of memory (program, data and flash memory), a RF transceiver (usually with single omnidirectional antenna), a power source (for example., batteries and solar cells), and contain various sensors and actuators [3]. One or more than one nodes in the network will aid as sink(s) which exchange the data or information with the user either directly or by the way of existing wireless networks [4].

Classification of Routing Protocols:

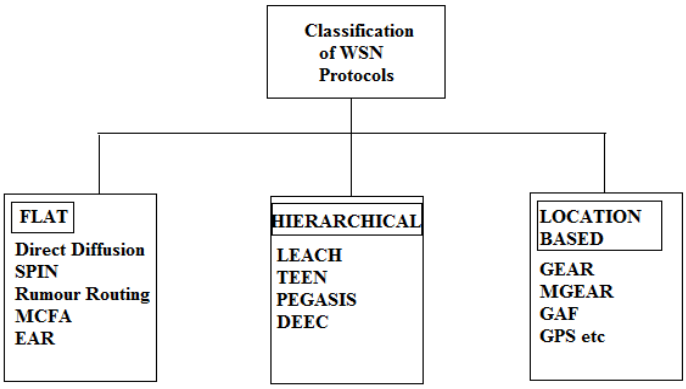

Figure 1: Classification of Routing Protocols

- Flat routing protocols are designed for network structure with homogeneous nodes meaning all nodes have the same transmission and processing capability. Directed Diffusion, Sensor Protocol for Information via Negotiation (SPIN), Rumour Routing, Minimum Cost Forwarding Algorithm (MCFA), Energy Aware

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Routing (EAR) can also be added in this category. In this group of protocols they demonstrate several advantages such as low topology maintenance overhead and the ability of multi-path discovery.

Another group of protocols is the hierarchical routing protocols which were proposed to increase the scalability of the network and make the network energy efficient through node clustering. In this group of protocols all the sensor nodes are grouped into clusters and each cluster will have a cluster head which will be responsible for the collection of data from its cluster nodes, data processing and then forwarding the data towards the sink.. Though this structure provides high network scalability, clustering operation but the cluster head replacement impose high signalling overhead to the network. Several routing algorithms such as Low-Energy Adaptive Clustering Hierarchy(LEACH), Threshold-Sensitive Energy-Efficient Sensor Network Protocol(TEEN) fall in this category [2]. Heinzelman, et al. [7] introduced LEACH. It is one of the most popular hierarchical cluster-based routing protocols which include distributed cluster formation. The main idea is to form clusters of the sensor nodes based on the received signal strength and use a local cluster head (routers) to the sink. Energy is saved from this protocol since transmission will only be done by cluster heads rather than the all sensor nodes. LEACH uses a TDMA/code-division multiple access (CDMA) MAC to reduce inter-cluster and intra-cluster collisions. This protocol mainly proposed for the conditions like sudden changes in the sensed attributes such as temperature [9]. The network is operated in a reactive mode in where responsiveness is important for time-critical applications. CH sends two types of data to its neighbours—one is the hard threshold (HT) and other is soft threshold (ST). The hard threshold value is used for the sensing the attribute. It is absolute value of the attribute beyond which, the node sensing this value must switch on its transmitter and report to its cluster head. Moreover, hard threshold tries to reduce the number of transmissions by allowing the nodes to transmit only when the sensed attribute are in the range of interest. Small change in the value of the sensed attribute that triggers the node to switch on its transmitter and transmit the data form the soft threshold. It reduces the number of transmissions by eliminating all the transmissions which might have occurred when there is little or no change in the sensed attribute once the hard threshold.

The next group of routing protocols utilizes the exact location of the sensor nodes for the routing purposes. The geographic Location of the nodes can be obtained directly using Global Positioning System (GPS) devices or indirectly through exchanging some information regarding to the signal strengths received at each node. Since the localization requires special hardware support and also imposes significant computation overhead, this approach cannot be easily used in resource constrained wireless sensor networks. Geographic and Energy-Aware Routing (GEAR) and Geographic Adaptive Fidelity (GAF) can be referred as the geographic routing protocols.

III. PROPOSED WORK

The paper presents a threshold based method, for clustering of nodes in the network. The threshold value is decided by the energy remaining in the nodes as well as their distance from the base station and from their current cluster heads. The nodes are classified into various types, depending their respective energies. They are normal nodes, advanced nodes and super nodes. Let m be the fraction of the total number of nodes N, and mo is the percentage of the total number of nodes which are equipped with b times more energy than the normal nodes, called as super nodes, the number is N.m.mo. The rest N. m. (1-mo) nodes are equipped with a times more energy than the normal nodes, called as advanced nodes and remaining N. (1-m) as normal nodes.
The threshold for the selection of cluster is given by the following equation:

$$T(s) = \begin{cases} p/1-p(r\bmod(1/p)) & \text{if } s \in G \\ 0 & \text{Otherwise} \end{cases} \quad (1)$$

Where, p is the probability or chance.

The selection probabilities of normal, advanced nodes are defined as:

$$\text{Normal} = n*(1-m)$$

$$\text{advance} = n*m*(1-mo)$$

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super = n*m*mo (2)

where,m is the total number of nodes and mo is number of nodes equipped with b times higher energy than normal nodes.

Probability of normal, advanced nodes

$$p_i = \begin{cases} \frac{p_{opt} E_i(r)}{(1+am)\overline{E}(r)} & \text{if } s_i \text{ is the normal node} \\ \frac{p_{opt}(1+a)E_i(r)}{(1+am)\overline{E}(r)} & \text{if } s_i \text{ is the advanced node} \end{cases} \quad (3)$$

Calculate Probability of selection depending on the average energy of the network at roundr, hence the average energy is estimated as:

$$\overline{E}(r) = \frac{1}{N} E_{total} \left(1 - \frac{r}{R}\right) \quad (4)$$

The total energy dissipated Eround is equal to:

$$E_{round} = L(2NE_{elec} + NE_{DA} + kE_{amp} d_{toBS}^4 + NE_{fs} d_{toCH}^2) \quad (5)$$

Where, k is number of clusters dtoBS is the average distance between cluster head and the base station and dtoCH is the average distance between the cluster members and the cluster head.

$$d_{toCH} = \frac{M}{\sqrt{2\pi k}} d_{toBS} = 0.765 \frac{M}{2} \quad (6)$$

Where calculating the derivative of Eround with respect to k to zero we get optimal number of clusters as:

$$k_{opt} = \sqrt{\frac{N}{2\pi}} \frac{M}{d_{toBS}^2} \sqrt{\frac{E_{fs}}{E_{amp}}} \quad (7)$$

IV. SIMULATION RESULTS

The network environment was simulated using MATLAB tool, which gives various kinds of simulation graphs for analysis of the methods. The simulation network parameters used are as shown in the below table:

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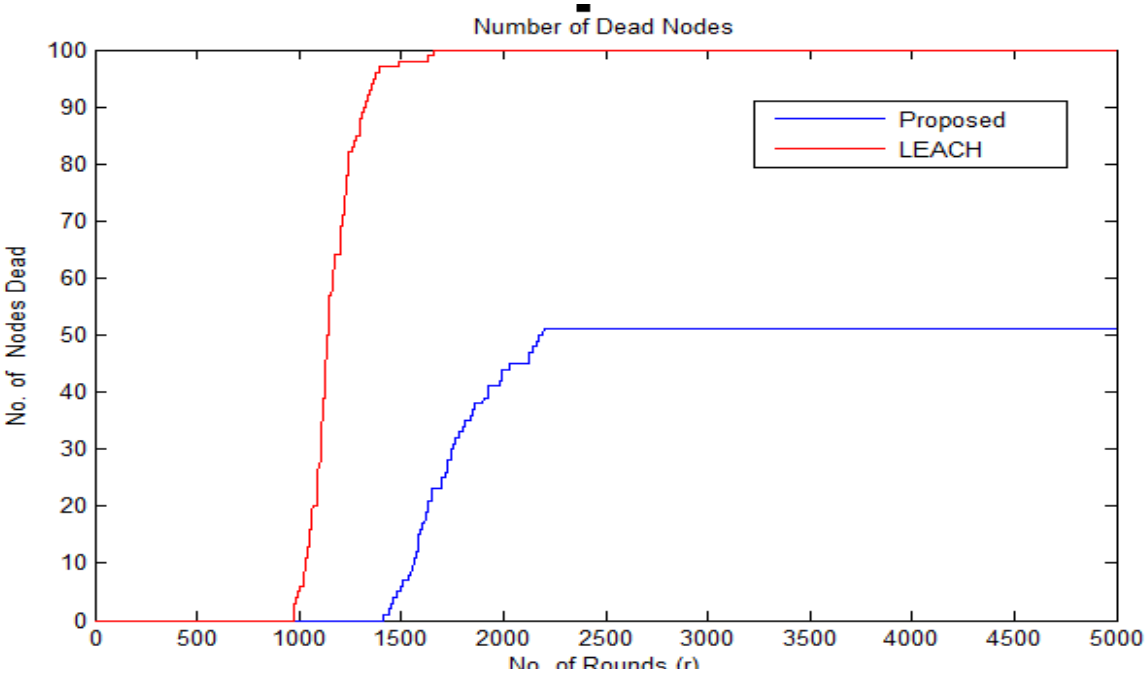

Fig.2. Number of Dead Nodes

Fig 2. shows the number of dead nodes compared against the basic LEACH algorithm. As, can be seen from the graph, the proposed method shows a better performance, after 5000 rounds the proposed method has only 50 nodes dead whereas in LEACH all 100 nodes are dead which makes it an efficient method.

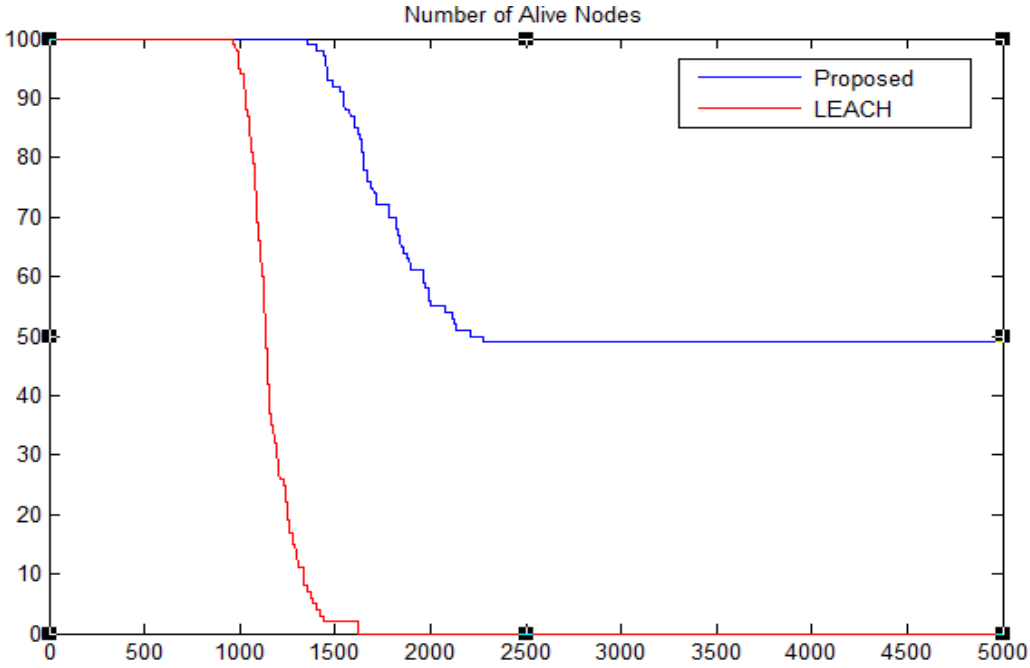

Fig. 3. Number of Alive Nodes

The graph in Fig 3, shows that after 5000 rounds proposed method have the large number of alive nodes remaining and it is clear from these two graphs that the method greatly improves network lifetime and makes it efficient.

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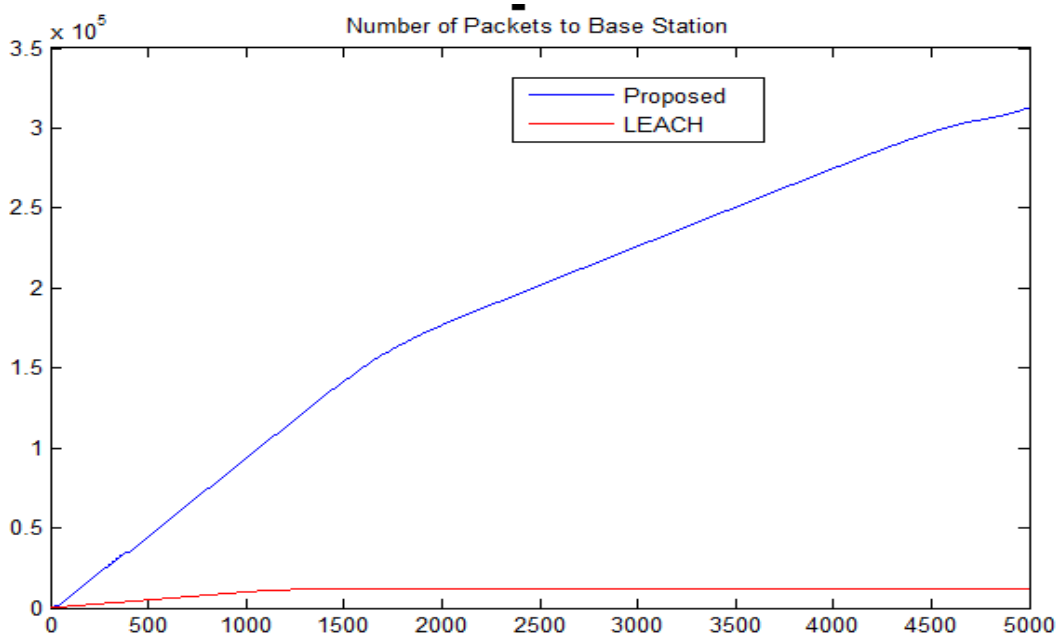

Fig 4: Number of Packets Sent to BS

Not only this, the throughput of the network, i.e. the number of data packets transferred from cluster heads to the base station also shows a very high improvement in the proposed method, as is visible from Fig 4.

V. CONCLUSION AND FUTURE WORK

The Wireless Sensor Networks can have stringent power limitations. This paper presents an insight into the various factors which can be used to save this power and increase the lifetime. The method presented in this paper uses both the remaining energy of the nodes and distance from base station and cluster heads to decide the threshold for cluster heads selection. Depending on the number of nodes remaining, it divides the nodes into normal, super and advanced nodes based on threshold values. Overall, the method gives an increased efficiency and increases lifetime of the network.The proposed algorithm proves energy efficient and maximizes the lifetime of entire network.

REFERENCES

1. F. Akyildiz, et al, "Wireless sensor networks: a survey", *Computer Networks*V, Vol. 38, pp. 393-422,2002.
2. K. Sohrabi, et al, "Protocols for self-organization of a wireless sensor network," *IEEE Personal Communications*, Vol. 7, No. 5, pp. 16-27, 2000.
3. R. Min, et al., "Low Power Wireless Sensor Networks," *International Conference on VLSI Design, Bangalore, India*, 2001.
4. J.M. Rabaey, et al., "PicoRadio supports ad hoc ultra low power wirelesse networking", *IEEE Computer*, Vol. 33, pp. 42-48, 2000.
5. R. H. Katz, J. M. Kahn and K. S. J. Pister, "Mobile Networking for Smart Dust," *5th Annual ACM/IEEE International Conference on Mobile Computing and Networking(MobiCom'99), Seattle, WA*, 1999.
6. I.F.Akyildiz,W.Su,Y.Sankarasubramaniam,E.Cayirci, "Wireless SensorNetworks:A survey", *Elsevier science B.V.*, 2002.
7. Heinzelman W. B., Chandrakasan A. P., Balakrishnan H., "An applicationspecific protocol architecture for wireless microsensor networks," *IEEE Trans on Wireless Communications*, Vol. 1, No. 4, pp. 660-670, 2002.
8. Agam Gupta, Anand Nayyar,"A Comprehensive Review of Cluster-Based Energy Efficient Routing Protocols in Wireless Sensor Networks", *International Journal of Research in Computer and Communication Technology*, Vol.3, Issue 1, pp. 104-110, 2014.
9. Shio Kumar Singh, M P Singh and D K Singh, (August 2010), "A Survey of Energy-Efficient Hierarchical Cluster-Based Routing in Wireless Sensor Network," *Int J. of Advanced Networking and Applications*, Vol.02, Issue:02, pp. 570-580, 2010.
10. Younis and S. Fahmy, "HEED: A Hybrid , Energy-Efficient, Distributed Clustering Approach for Ad-hoc Sensor Networks," *IEEE Transactions on Mobile Computing*, vol. 3, no. 4, pp. 366–379, 2004.
11. A Manjeshwar and D. P. Agrawal, "TEEN: A Routing Protocol for Enhanced Efficiency in Wireless Sensor Networks", *In Proc. of 15th International Parallel and Distributed Processing Symposium*, pp. 2009–2015, 2003.
12. Xiaoli Li, Hongchi Shi, and Yi Shang," A Sorted RSSI Quantization Based Algorithm for Sensor Network", Transactions on Mobile Computing,Vol. 6, Issue 11, pp. 1284-1296, 2007.

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ISSN (Print) : 2320-9798

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(An ISO 3297: 2007 Certified Organization)

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13. Localization" Proceedings of the 2005 11th International Conference on Parallel and Distributed Systems (ICPADS'05), 2005.
14. The MathWork - MATLAB and Simulink for Technical Computer: http://www.mathworks.com

BIOGRAPHY

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