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A Relative Study and Analysis of Various Energy Efficiency Schemes in Wireless Sensor Networks

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ABSTRACT: The energy efficiency is one of the most stringent requirements to develop any real time application using wireless sensor in harsh ad-hoc networking scenarios. The wireless sensor nodes are deployed in large numbers in the environments like hilly terrains, forests, oceans or marine locations. The physical access to the nodes deployed in this area or the human intervention forms a major inconvenience because of which it becomes necessary to have an energy efficient performance in sensor nodes which can be judged in terms of routing, coverage, connectivity. These are the parameters from which we can make how effectively the area is covered by the deployment of sensor nodes. The paper presents a relative study and analysis of various energy efficiency schemes for wireless sensor networks.

KEYWORDS: sensor networks, efficiency, average energy, dead nodes, node power, round, analysis, improvement.

I. INTRODUCTION

The energy conservation and the smart energy performance of sensor nodes play a vital role in wireless sensor networks. The energy efficiency can be achieved and judged in terms of routing, coverage and connectivity for the sensor nodes. The term routing incorporates the whole scenario of the data being circulated from one node to another and finally to the base station or the sink node which further sends the information to the required places. The clustering plays a key role in sensor network environment when the routing of data is considered. The randomly deployed sensor nodes will form small groups called as clusters. A node will be appointed as a cluster head, all the send their transmission to the head and it will be then forwarded to the base station. If each node has equal likelihood to become a cluster head, then the total area will be effectively covered for longer time. This is the basic concept of LEACH (Low Energy Adaptive Clustering Hierarchy) protocol because of which is can be used in routing as well as coverage schemes.

The paper [1] proposes LEACH protocol in which all the data from nodes is sent to a cluster head, aggregated compressed and sent to the sink node. A stochastic algorithm decides the probability of the node in the cluster to become head in the round. The assumption made is that each node has sufficient radio power to send the data to the cluster head or base station whichever is nearer to it. This causes not a disciplined use of power associated with each sensor node. However the primary objective of it is to lower the energy usage in wireless sensor nodes to improve the lifetime of the network. The paper [2] proposes a SEP (Stability Election Protocol) which is a heterogeneous protocol to elongate the time before the first node actually dies. The probability of the node to become cluster head is weighted depending upon the remaining energy of that node. The protocol used for the sensor nodes will increase the stability of the network. The paper [3] proposes a TEEN (Threshold Sensitive Energy Efficient Network) protocol which is the first protocol developed for reactive networks and used in temperature sensing application that divides the sensor nodes

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twice for grouping cluster in order to detect the sudden changes in the sensed attributes. The paper [4] proposes a PEGASIS protocol (Power Efficient Gathering in Sensor Information Systems) in which each of the node in the network environment will receive a data from its neighbor, fuses its own data with it and send the complete package of data to the next node in the chain.. The further context presents the simulation results for these protocols and the comparative analysis of it.

II. PROTOCOL PERFORMANCE IN TERMS OF AVG NORMALISED ENERGY AND NO OF DEAD NODES

The performance of LEACH, TEEN, SEP and PEGASIS protocols in terms of average energy of node and no of dead nodes after successive number of rounds is explained below. The average node energy in case of LEACH protocol is as shown below. As the round no increases, the average energy of the node also decrease linearly and further the energy of the node drops down to zero.

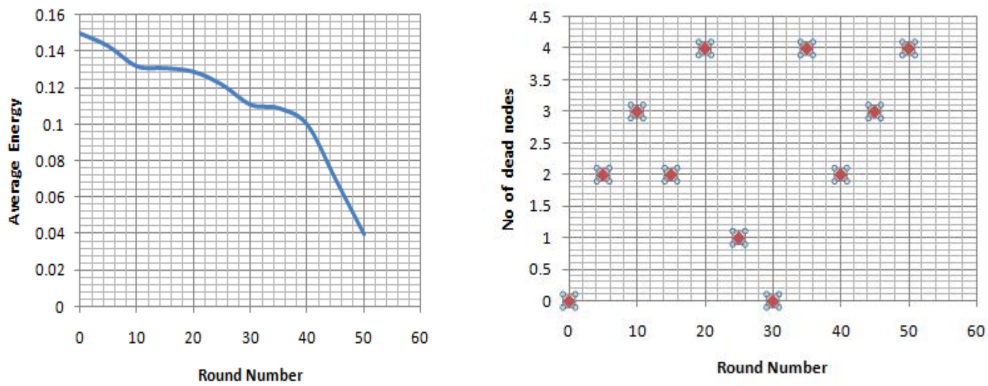

Fig no.1: Average energy of node and no of dead nodes for LEACH protocol.

The protocols TEEN and SEP outperform LEACH in terms of average energy of a node and the number of dead nodes as compared to LEACH protocol which is shown below.

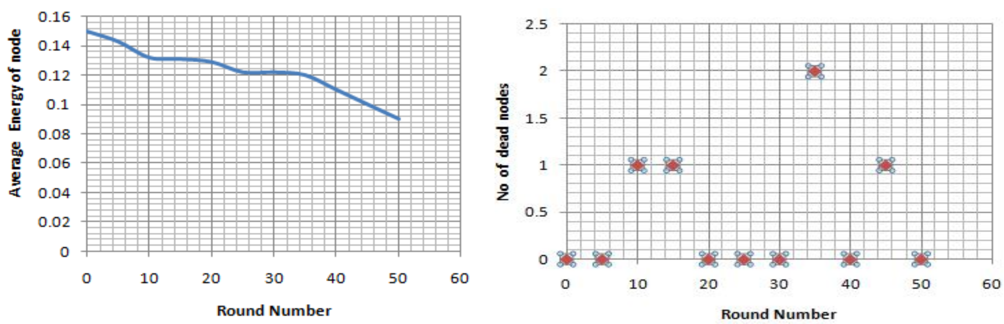

Fig no.2: Average energy of node and no of dead nodes for TEEN protocol.

The results of simulation show that average energy of node in TEEN protocol decrease when the round number successively increase. The fifty rounds indicate the total simulation time being around 1500 seconds. However the protocol results are better than the results obtained for LEACH protocol in both the cases i.e. average energy of node and the no of dead nodes. The energy efficiency can be enhanced by developing a energy model based on statistics and mathematical principles which can enhance the average energy of each node and decrease the no of dead nodes. The performance of SEP protocol in terms of average energy of node and no of dead nodes after successive no of rounds is as shown below:

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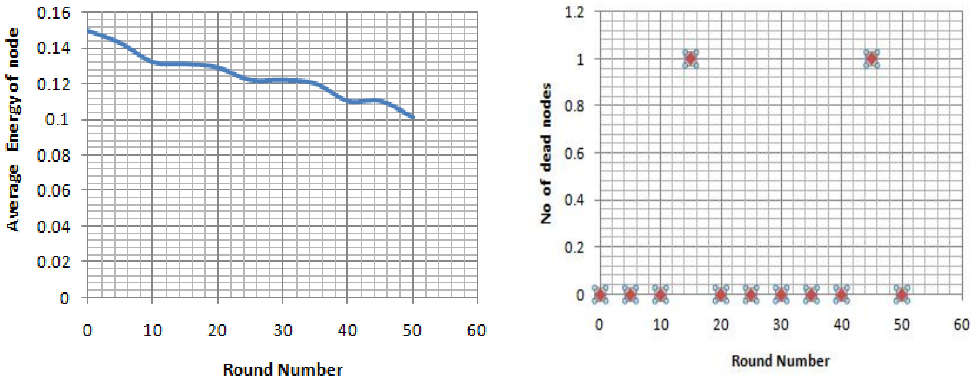

Fig no.3: Average node energy and no of dead nodes in SEP protocol.

II. COMPARATIVE ANALYSIS OF PERFORMANCE OF PROTOCOLS

For the comparative analysis of the results obtained of the average energy of node and the number of dead nodes in the LEACH, SEP and TEEN protocols we plot the following graph.

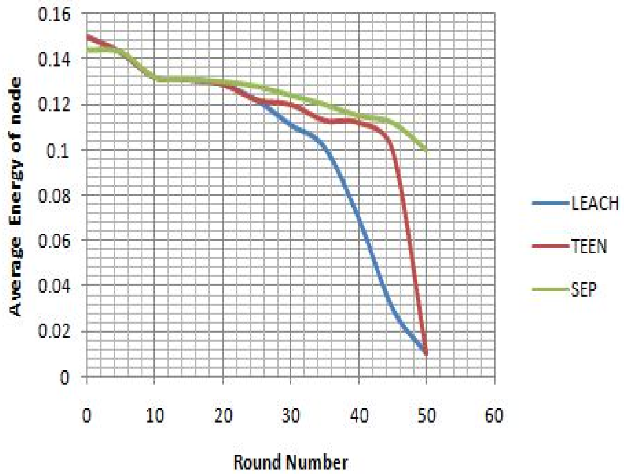

Fig No.4 : Comparison of average energy of nodes in LEACH TEEN and SEP protocols.

Thecomparison of the results obtained for average energy of the nodes for all the three protocols is highlighted and the average energy of the node drops down to a very less value with increasing number of rounds in LEACH protocol to a very lesser value. The average life of node sharply declines in the next case which shows the requirement of enhancement in the life of node by increasing its energy efficiency as well as stability of the network i.e. sustaining energy with icreasing rounds in simulation uniformly .The SEP protocol protocols performs gives best performance in the terms of average energy of node. The residual levels of energy for a node when it becomes active in sensing and transmitting at its random time till the current time plays an important role in development of any energy efficiency algorithm in sensor networks.
The no of dead nodes arising after successive number of rounds for all the three protocols is shown in the following figure:

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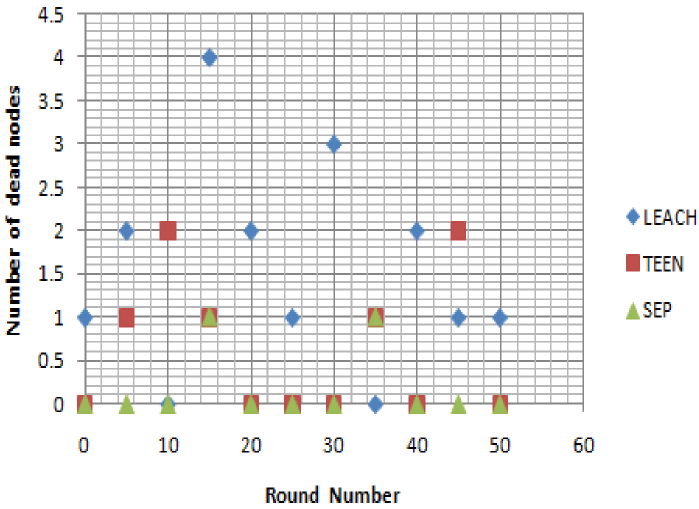

Fig no.5: Number of dead nodes after successive no of rounds for LEACH, TEEN & SEP Protocols.

The SEP Protocol gives a better performance in terms of number of dead nodes after increasing number of rounds. This protocol is capable of keeping alive the large no of sensor nodes and restoring their radio power for the nodes for large number of rounds. The energy efficiency of the sensor node network also determines the stability of the system. The SEP prolongs the stability period for higher values of extra energy brought by more powerful nodes. Thus the over analysis of the performance of all the protocols stated earlier show that SEP performs relatively better in terms of smart energy performance of the nodes.

III. CONCLUSION

The conservation of energy and robust energy behavior of sensor nodes plays a very important role in developing any real time application using wireless sensor networks. The energy efficient performance can be judged in terms of effective routing, coverage and connectivity. The various schemes to achieve energy efficiency in wireless sensor networks were studied and the comparative analysis of their performance of them was made. It is found that SEP protocol outperform LEACH and partly TEEN protocol in terms of average energy of node and no of dead nodes with successively increasing number of rounds. The energy efficient performance yields to stability of nodes. SEP yields longer stability region for higher values of extra energy brought by more powerful nodes. The future scope of work in this direction is to develop different mathematical models leading to the optimal power consumption and reduction in the probability of no of dead nodes.

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Dr.KTV Reddy has completed his PhD from IIT Mumbai. He presently works as Professor in Dept of Electronics & Telecommunication Engineering at Fr.C Rodrigues Institute of Technology, Vashi. His research interests are Broadband Microstrip Antennas, Arrays, Microwave Integrated Circuits, Software Development for Antenna Synthesis and Design, Mobile Antennas and Signal Processing..

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