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Prolonging Network Lifetime by Assigning Higher Energy to Relay Head Node

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Abstract- A wireless network (WSN) is composed of sensor nodes which are randomly distributed over the network. In this dissertation, a network is taken in which nodes are randomly deployed in (100*100) m^2 area for collecting and aggregating data and transmit it to base station (i.e. sink node). For this purpose in proposed work nodes are arranging in hierarchy by using suitable algorithms and partitioning of network into 3 areas (named tiers). After that a head is chosen among all nodes based on their distance from base station. A node which has minimum distance from base station will be head node in the network and assigning higher energy to head node to increase network lifetime in comparison to previous designed protocols. In this work load is equally distributed to all nodes to achieve long network lifetime. This proposed work is implemented in c++; this proposed protocol is named as prolonging network lifetime by assigning higher energy to relay head node. The result obtained in this work is 1.2x better than MSMTP protocol.

Keywords-MSMTP, WSN, BS, MTP, AMPS

I. INTRODUCTION

Trying to make homogeneous WSN, which in addition to collect data from the nodes of the network, a relay head node will aggregate the data which is to be transmitted to base station. The data to relay head node is transmitted through multi hop routing i.e. different nodes will collect data from different nodes and pass them to their neighbour nodes which in turn pass the data further to their neighbour nodes and finally the data will be available at relay head node which has highest energy among all nodes, Which in turn transmit data to base station.

II. REVIEW OF LITERATURE

Author is trying to minimize reduction in system energy by first generating MST between all sensor nodes so as to minimize their transmission energy with in network and after that a node of highest energy among the top tier will transmit the aggregated data of whole network to base station. Maintaining network topology same until any node of network dies another highest energy node from top most rank tier is chosen to communicate with BS. This technique achieves 10x to 20x improvement in system life time as compare to MTP.Authors considered wireless sensor networks where the sensors are randomly distributed over an area of interest. The locations of sensors are keeping fixed and the base station knows that all priori. The sensors are in direct communication range of each other and can transmit to and receive from the BS. The nodes periodically sense the network and have always data to send in each round of communication. The nodes aggregate the data they receive from the others with their own data, and maintain only one packet regardless of how many packets they receive. The problem is to find a routing scheme to deliver data packets collected from sensor nodes to the base station [1]. LEACH (Low-Energy Adaptive Clustering Hierarchy) is a clustering-based protocol that utilizes randomized rotation of local cluster base stations to evenly distribute the energy load among the sensors in the sensor network. Simulations shows LEACH can achieve as much as a factor of 8 reductions in energy dissipation compared with conventional routing protocols. LEACH also distributes energy consumption evenly throughout the sensors, increasing the lifetime of the system. Authors consider micro sensor networks where the base station is fixed and is located far from the sensors and all nodes in the network are homogeneous and energy constrained. Thus, communication between the sensor nodes and the base station was expensive, and were no “high-energy” nodes through which communication can proceed. There was the framework for MIT’s AMPS project, which lights on innovative energy-optimized solutions at all levels of the system hierarchy, from physical layer and communication protocols up to the application layer and efficient DSP design for micro sensor nodes. Sensor networks contain too much data for an end-user to process [2]. In this paper (Power-Efficient GAthering in Sensor Information Systems), a optimal

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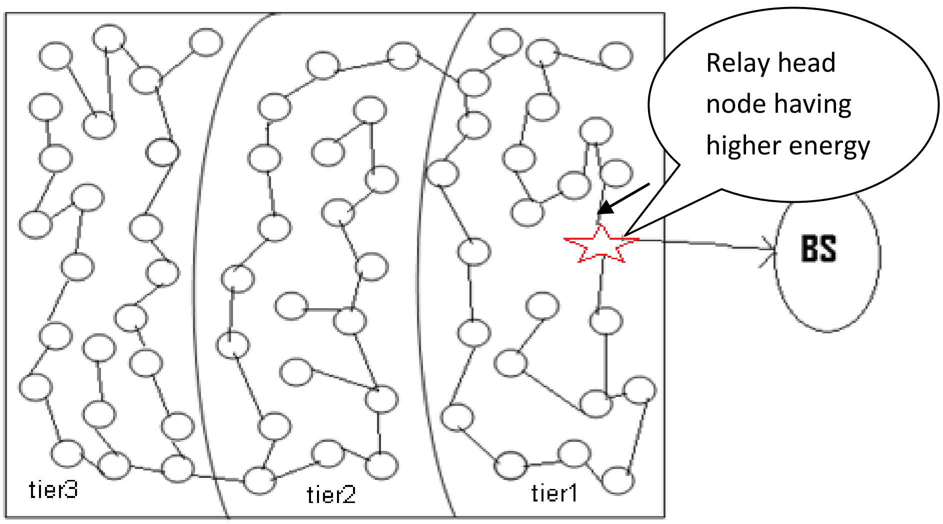
chain-based protocol that is better over LEACH, in PEGASIS each node communicates only with a close neighbor and takes turns transmitting to the BS, thus reducing the amount of battery spent per round. Simulation results show that PEGASIS output better than LEACH by about 100 to 300% when 1%, 20%, 50%, and 100% of nodes dead for different network sizes and topologies. Here BS is located at (25, 150) which is at least 100m from the nearest node. In each round of this data-gathering application, data from existing nodes need to be collected and forwarded to the sink node, where the end-user can access the data. PEGASIS: Power-Efficient Gathering in Sensor Information Systems directly to the sink node. Since the BS is located far away, the cost to transmit to the BS from any node is high and nodes will die very soon. Therefore, an improved approach is to use as few transmissions as possible to the BS and minimize the amount of data that must be transmitted to the BS. In sensor networks, data fusion helps to reduce the amount of data transmitted between sensor nodes and the BS [3]. In this paper author is saying that each sensor node detects the distance between the base station and itself. Then, he calculates a tier ID in according to the distance. A lower tier ID indicates a shorter distance between the base station and the node. Nodes with higher tier IDs send data to their neighbours with lower tier IDs, where data is compressed and forwarded toward nodes of even lower tiers. Eventually the data reaches the nodes at the lowest tier, and then the system selects a node sending data to the base station. Because long-distance communication between the base station and the node is energy-consuming, it will have its battery drained off faster than other nodes. The protocol employs a method to shift the long-distance communication among all network nodes. Thus, energy consumption is evenly distributed among all network nodes. Initially, the sensor nodes with the lowest tier ID (closest to the base station) are the top-tier nodes. Because top-tier nodes directly communicate with the base station, their energy is drained off very quickly. When the remaining energy for those nodes is less than the energy threshold, those nodes are unsuitable to communicate with the base station. In this case, the MTP algorithm chooses other nodes, which are farther away from the base station but with higher remaining energy, to communicate with the base station. This is called the top tier shifting mechanism [4].

III. ABOUT PROPOSED WORK

In proposed work homogeneous WSN is using, which in addition to collect data from the nodes of the network a relay head node will aggregate the data which is to be transmitted to base station.



Figure(a) Proposed Architecture when transmission is through tier1

The data to relay head node is transmitted through multi hop routing i.e. data will be collected from different nodes and which in turn pass the data further to their neighbor nodes and finally the data will be available at relay head node which has highest energy among all nodes, which in turn transmit data to base station.

In approach of multi hop routing [5] the data to be collected at relay head node is collected by minimum spanning tree approach in which a node will send data to those neighbors which have the minimum cost for tree generation, after all this the graph is fully connected and spans minimum cost overall and is connected in the form of tree which have not any cycle. In addition here we are considering homogeneous nodes, so here all nodes having same energy. Initially a node chosen as a head has minimum distance from the base station and assigned maximum energy to relay head node for extending network life time, managing load on the network and will communicate with the base station. After this transmission, relay head node will be replaced by some other node having highest energy which will act as head for that round and this procedure will be repeated for the entire network and every time a node of highest energy will be chosen.

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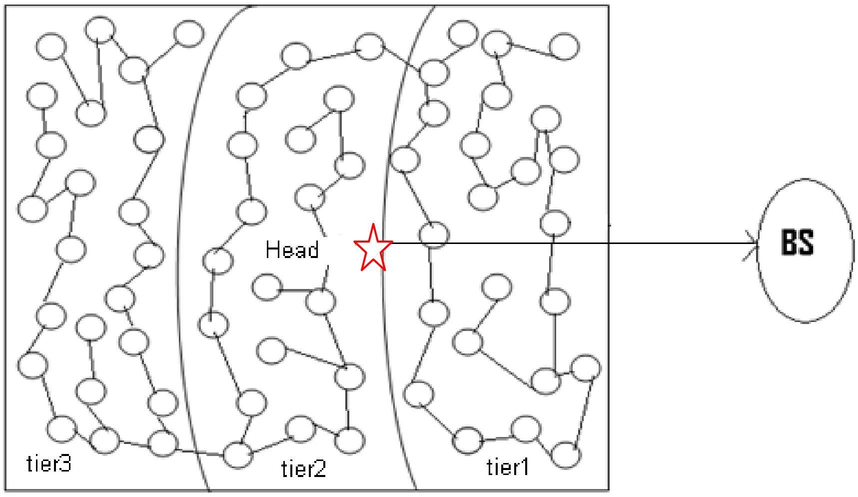


Figure (b) Proposed Architecture in top tier shifting approach

Also the network is divided in to three areas known as tiers, where nodes belonging to tier1 will have the minimum distance from base station and nodes of tier3 have the farthest while that of tier2 is intermediate between these two. First we will prefer nodes of tier1 to transmit data to base station which have energy greater than threshold one, when all nodes of tier1 have energy below threshold one then nodes of tier2 will transmit data to base station and this procedure will be shifted to nodes of tier3. This procedure is known as TOP TIER SHIFTING [4]. When all nodes of tier3 have energy below threshold then a new threshold is defined. This procedure is continued until threshold goes below dead energy, at that moment all nodes of network are dead. The equations used to calculate transmission costs and receiving costs for a *k*-bit message and a distance *d* are shown below:

Transmitting

$E_{tr}(k,d) = E_{elec}(k) + E_{amp}(k,d)$

$$= \begin{cases} kE_{elec}+kE_{amp}d^2 & \text{with in network} \\ kE_{elec}+kE_{amp}d^4 & \text{transmission to BS} \end{cases}$$

Receiving

ERx(k) = ERx-elec(k)

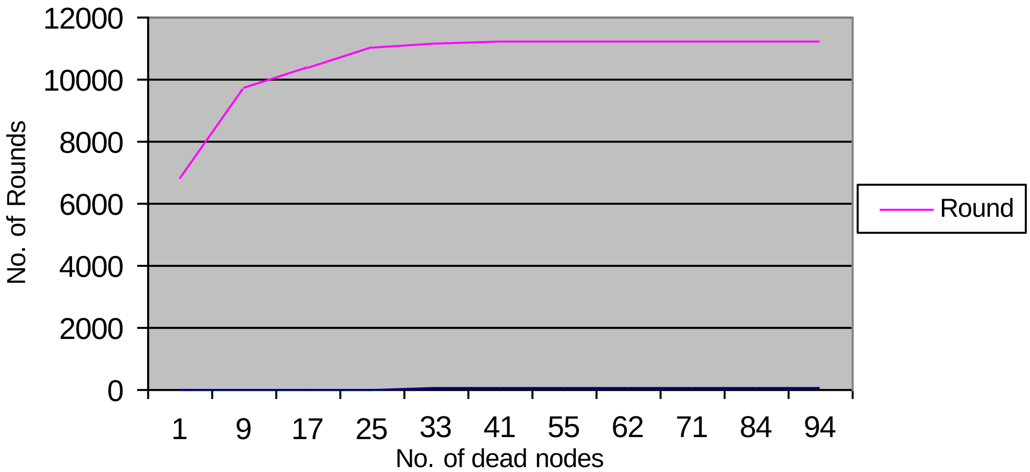
$E_{Rx}(k) = E_{elec}*k$

In this model, a radio dissipates E_{elec} = 50 nJ/bit to run the transmitter or receiver circuitry and Îamp = 100 pJ/bit/m2 for the transmitter amplifier. The radios have power control and can expend the minimum required energy to reach the intended recipients. The radios can be turned off to avoid receiving unintended transmissions. An r2 energy loss is used due to channel transmission [10, 11].

V. EXPERIMENTAL RESULTS

Performance evaluation methodology firstly explained performance metrics and based on these metrics some experimental results are shown for different initial energy of nodes in the network. The results are then compared with previous values of proposed models and are simulated in c++.

This section includes results of proposed work, graph below give details for the round number corresponding to which a node is died.



Figure(c) Round number corresponding to which a node is died

The graph in figure (c) shows round number corresponding to which a node is died, these results are simulated on a network comprising of 100 nodes spread in the area of (100 *100) ^{m2}. All the nodes are having initial energy 6.4 joule and base station is located at (25,250) which are at least 150m distant from the nearest node. A node is considered to be dead when its energy goes to a level of dead energy which is assumed to be 0.02J. Initially threshold energy is defined to be 0.256J which is further redefined to its half of its previous value and when energy of all nodes goes below threshold level. When threshold goes below defined dead energy for a node, the network is declared to be dead.

Figure (d) and (e) shows the relationship between the network lifetime and the distance of the base station located at 250 and 300. Proposed work is based on MTP but because of generation of minimum spanning tree for communication among nodes and assigning higher energy to relay head node among all nodes of the network; we got better results than previous protocols. Major advantage of proposed protocol is increased network stable life time i.e. the time when all nodes of the system are alive, also the overall life of proposed solution is better than existing protocols.

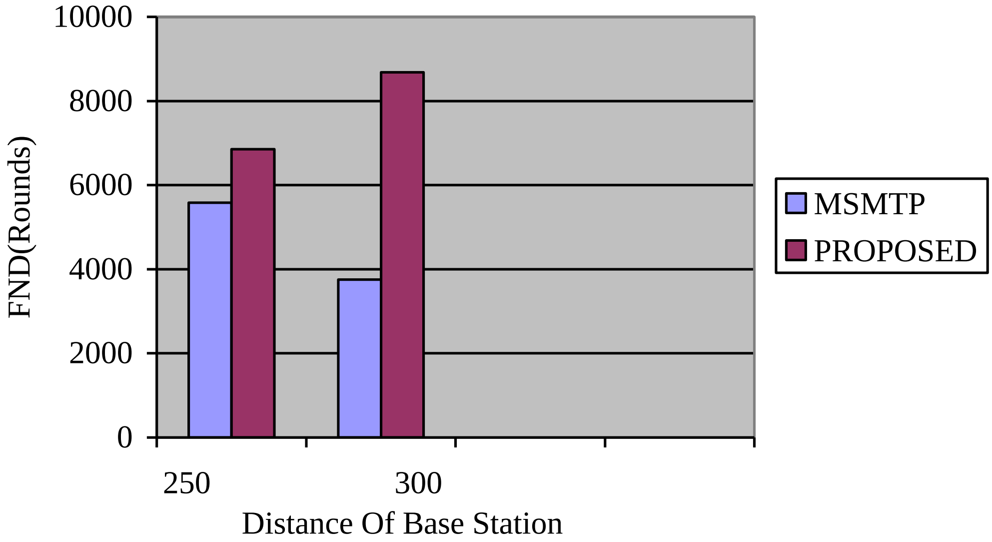


Figure (d) FND vs. Distance of base station

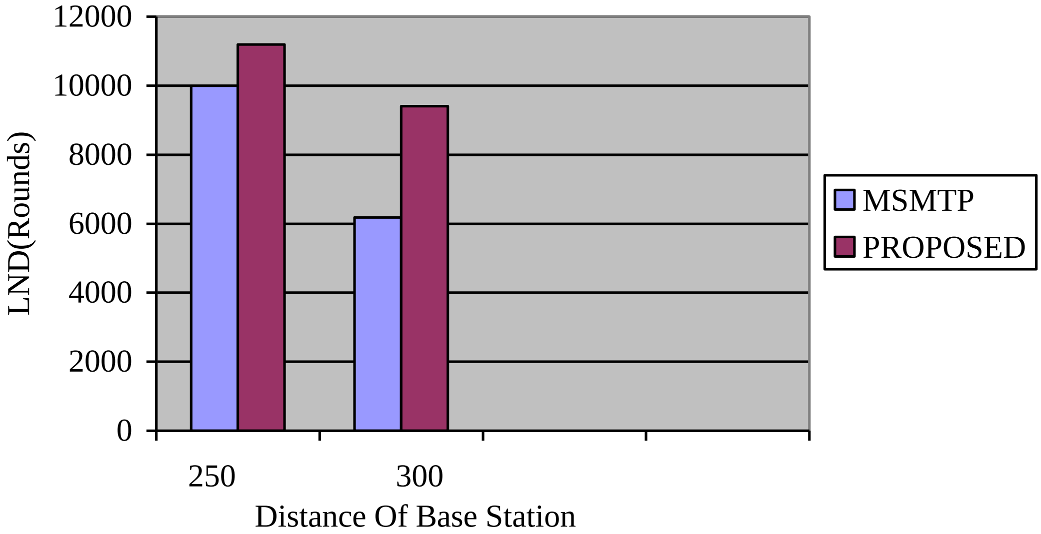


Figure (e) LND vs. Distance of base station

In order to evaluate the performance of proposed protocol, it simulated on 100 node network as shown in figure (c). The BS is located at different locations far from the 100 m×100 m field which is at least 150 meters distant from the nearest node. Also simulations are checked when distance of base station is varied from network area & is checked at the distance of 250, 300 from the nearest node of the network.

Table (a) shown below compares results of MSMTP techniques including the proposed one in different cases when 1%, 20%, 50%, 100% of nodes are died having initial energy of nodes are 6.4J/node; the previous results are referred from [1]. From the table it is clear that proposed protocol results are better than the existing protocols in all stages of the network.

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Table (a) Number of rounds when 1%, 20%, 50%, 100% nodes die in the area of 100m*100m network

Energy J/Node	Protocol	1%	20%	50%	100%
6.4	MSMTP	5584	8869	9816	10000
	PROPOSED	6853	10570	11196	11196

Table (a) shows the performance of proposed work with MSMTP protocol. The proposed work shows the network performs 1.2x better than MSMTP.In proposed work all nodes initially has 6.4 joule energy but due to assigning higher energy to head node make proposed protocol 1.2x better.

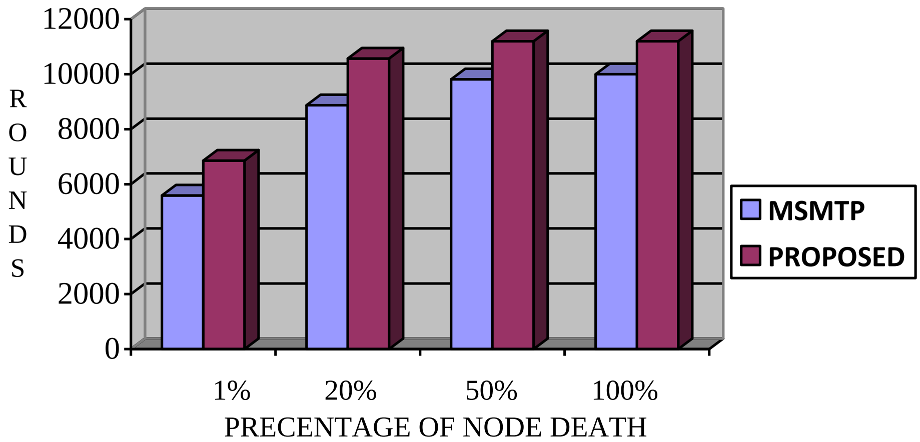

Figure 4.4 Performance results for a 100m*100m network with initial energy 6.4J/node

V. CONCLUSION

In this dissertation a routing strategy based on minimum spanning tree and tier formation of nodes is proposed. Through simulation the results are proved to be better than LEACH, PEGASIS and MSMTP which was near to optimal routing protocol. In each round of communication construction of minimum spanning tree tries to balance the load among the nodes. The distribution of load evenly to all nodes has a great impact on system lifetime.

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