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Numerical Simulation and Comparative Analysis of Energy Efficient Routing Protocols in Wireless Sensor Network Under Parametric Variation

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Abstract— Environmental and bioprocess monitoring are some of the applications where the development of sensors, particularly biosensors and sensor networks, has proven most useful. With very few power sources, it is difficult to replace sensor nodes since sensor longevity is influenced by the presence of energy. The routing protocol must be energy-efficient in order to reduce energy consumption. Therefore, developing a routing protocol that is energy-efficient is essential. For WSNs, several routing protocols are envisioned. WSN routing is a particularly challenging operation because of the inherent characteristics of WSNs. Coverage, which measures how well a sensor is tracked or monitored in a wireless network, is one of the common problems that have happened. The location assessment problem presents the largest challenge in detecting the actual wireless network node position. Energy consumption focuses on the question of how much more energy is used in the WSN for data transmission and reception than for data collection and processing. Creating and understanding energy-efficient network techniques for wireless sensor node grouping is the aim of the research. One of the key design considerations for a sensor network is how to save energy in each sensor node. Wireless sensor networks are essential for networks to endure longer. In this aim, several routing methods were developed. The existence of the network has become dependent on the performance of the nodes of these classification algorithms. By clustering, a network of wireless sensors may be successfully expanded. In this work, she compares LEACH and EAMMH, two well-known routing protocols, for a variety of common scenarios and does a brief analysis of the consequences of the simulation on known energy and net life measures. This study presents the findings and outcomes of the evaluations of various methodologies. A well-known method for prolonging WSN life is the use of clustering-based routing protocols. In order to achieve energy savings for sensor nodes and minimize the amount of data transfer, the clustering concept of a routing is based on the information aggregation approach.

Index term: WSN, LEACH, Energy, Network Lifetime.

I. INTRODUCTION

One of the best innovations in WSNs is routing. In comparison, routing in WSNs is more exciting because of their inherent features in standard ad hoc networks. First of all, the availability, processing capacity and

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bandwidth of transmission resources are very small. Second, a global approach to Internet Protocol (IP) is difficult to design. In addition, IP can not be extended to WSNs, as the updating of addresses can lead to heavy overhead in wide or complex WSNs. Thirdly, it is difficult to manage evolving and frequent change in topology, especially in a mobile environment, due to the inadequacy of resources. Fourthly, the processing of data by several sensor nodes produces a high likelihood of data consistency calculated by the protocols for the routing. Most applications of WSNs do not allow a single multi-source communication device to be multi-cast or pair-to-peer applications. Lastly , data transfers should be carried out within a certain period of time for applications of WSNs with time constraints. Therefore, in these types of applications, minimal latency for data transfers should be considered. In many applications, however, energy security is more critical than service quality (QoS) since energy, which is directly linked to the network life, is limited by all sensor nodes.[11][13][14]

Routing protocols on WSNs may be split in two groups depending on the network structure: flat routing and hierarchical routing. Each node performs the same tasks and functionalities in the network in a flat topology. Data is typically transmitted hop by hop using the flood method. In small scale networks, flat routing protocols are fairly efficacious and are typical of a WSN's flat routing mechanism including flow and bogusing, sensor protocols for negotiation information (SPIN), direct diffusion (DD), greedy perimeter stateless routing (GPSR), trajectory-based forwarding (TBF), energy-aware routing (EAR), gradient-based routing (GBR), sequential assignment routing (SAR), etc. However, in large-scale networks it is relatively unnecessary since resources are limited, but all sensor nodes provide more data processing and bandwidth. On the other hand nodes perform various tasks in WSNs, in a hierarchical topology, and are usually clustered according to different requirements or measurements into numerous clusters. In general, each cluster includes the cluster head (CH) and other nodes (MN) or ordinary nodes (ONs) and CH may be arranged to form additional levels of hierarchy. In general , high energy nodes function as CHs and perform the task of processing and transmission of data, while low-energy nodes act as MNs and perform the task of sensing information. In WSN, traditional clustering protocols include Low Energetic Adaptive Clustering (LEACH), Hybrid Energy Efficiency Distributed (HEED), Weight-Based Distributed Energy Efficient hierarchy (DWEHC), Position-Based Aggregator Node Election (PANEL) Protocol, LEACH (TL-LEACH) two-level hierarchy, Unven Clustering size (UCS), Energy Efficiency (EEE) Model. .[21][13][18]

Energy Efficient Network Sensor (TEEN) protocol, Adaptive Threshold Sensor Sense Efficient Energy Sensor Network (APTEEN), two stage data distribution (TTDD), Focus Clustering Scheme (CCS), HGMR, etc. Due to many advantages, including greater scalability, data aggregation / fusion, less load, less energy consumption, more robustness, etc. Clustering routing is becoming an important field for routing technology in WSNs

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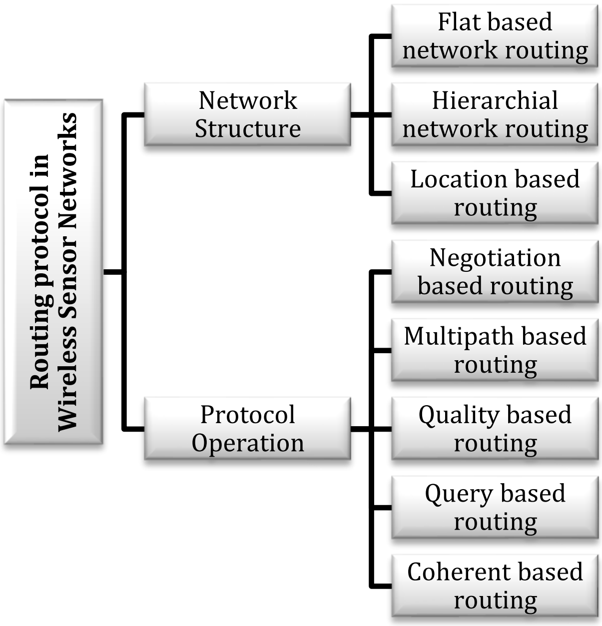

Figure 1.1 Routing protocols in in Wireless Sensor Networks

WSN routing protocols may differ depending on the application and design of the network. Routing in WSNs can in general be divided into flat, hierarchical, and location-based routing, depending on the layout of the network. All nodes usually have equivalent roles or features allocated for flat-based routing. However, nodes play specific roles in the network in hierarchical-based routing. The position of sensor nodes in location-based routing is utilized for network routing data. If such device parameters can be managed to adjust to current network conditions and energy levels, a routing protocol is called adaptive. In addition, these protocols can be categorized according to the operation of a protocol into multi-way, query-based, negotiated, QoS-based or coherent routing techniques. Furthermore, it is possible to categorize the routing protocols into three categories: proactive, reactive and hybrid according to what the path to the destination is contained in the original source. All routes are calculated in proactive protocols before they are actually required, while the routes are calculated on demand in reactive protocols. A mixture of these two concepts is used for hybrid protocols. If sensor nodes are static, routing protocols powered by a table would be preferred instead of using reactive protocols.

II. ENERGY AWARE MULTI-HOP MULTI-PATH HIERARCHICAL (EAMMH)

EAMMH is an intra-cluster network multihop protocol which arranged the sensor nodes into clusters. It establishes multiple tracks to the cluster head from every sensor node and offers an energy conscious heuristic feature to select the best path. EAMMH is a Hierarchical Routing Protocol to route wireless sensor networks energy efficiently. Energy-conscious routing protocols are mostly heuristic protocols which rely mainly on the energy of the next hop. Since sensor nodes have very little resources, and energy-conscious strategies avoid selecting sensors with very low energy in data transmission in order to extend network life. Thus, in balanced and effective routing protocols it is a good heuristic. In addition , the purpose of these protocols is to balance the communication load using the rest of the sensor nodes to balance energy consumption and to provide data reliability over multiple pathways. In this group, the protocols create routes by messages that are transmitted to the entire network. The main goal of message broadcasting is to collect and create the neighbouring table. Each node contains an adjoining table that stores important information

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about the adjacent nodes such as residual energy, hop distance and signal power.By using all the attributes that are in the list, the next table allows the node to determine on the next move.

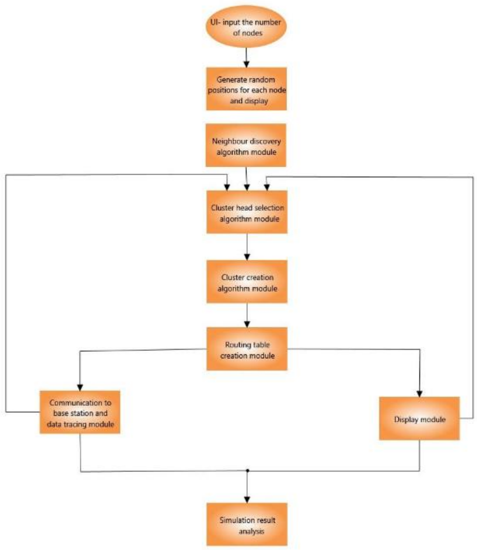

Figure2.1: Flow Chart of EAMMH

This scheme leads to a multiple road network built from the nodes to meet the requirements. Energy-sensitive protocols use reactive routing, which means that the route is only defined when necessary. This eliminates a great deal of overhead contact. Below are Energy Conscious Multihop Hierarchical Multi-Path (EAMMH) Routing Protocols. The EAMMH protocol for routing has been extended by inducing energy conscious routing faces and intra-cluster multi-hop routs..

For wireless sensor networks, we use the first order radio model shown in Figure 21. Any of these networks can be found here. When communicating with each other or with the BS, all sensors are within the radio contact range. Sensors will have the same sensing and processing capabilities as well as communication. In the heart of the sensor networks, BS is located and has an infinite supply of energy. Sensing data was ignored for the energy dissipation and for the energy dissipation for the clusters. In addition, we presume that all algorithms run on the BS cluster. The dissipation of energy from one bit data is a constant value. And the radio uses a k-bit message to relay a distance d: .[19][12]

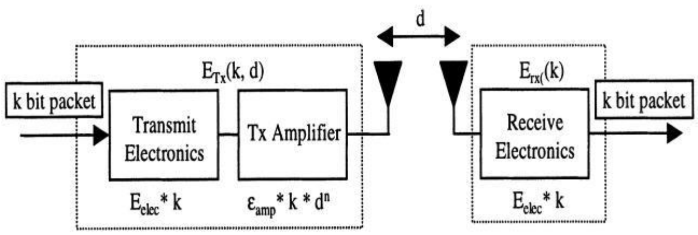

Figure 2.2 First Order Radio Model for Wireless Sensor Networks

$E_{Tx}(k,d) = k*E_{elec}+k*E_{fs}*d^{2} < 0$ (1.1)

$k*E_{elec}+k*E_{amp}*d^{4} \geq 0$ (1.2)

The first term reflects radio dissipation's energy consumption and the second term describes an enhancement radio energy usage. Depending on the transfer size, the use of free space Efs and the multi-way Emp canal models fading. The radio expends when it receives this data:

E_{Rx} (k) = k*Eelec. (1.3)

Additionally, data aggregation operation will consume the energy E_{DA}. In this way the protocol has been simulated using MATLAB.

III. METHODOLOGY

The discovery occurs in the configuration phase after the node deployment. This can be achieved by many methods such as k-of-n, ping, beacon messaging. After the next discovery, every node decides whether or not to be a cluster head for the current cycle when the cluster is formed. This is analogous to the LEACH form of judgement. The two key tasks operate in the setup process, cluster creation and selection (CH cluster head).

Data Transmission Phase -The sensor nodes are allocated timeslots for data transmission during the data transmission process. If nodes still send data, they send it at their specified time interval. If a node receives data from a neighbour, it applies its own data. When the aggregated data is forwarded, they must choose an appropriate route from their routing table entries. This decision is based on a heuristic function and heuristic function,

$h = K\ (Eavg\ /\ hmin * t)$ (1.4)

Where K is a constant, Eavg is average current path energy, hmin is a minimum current path hop number, t = current path traffic. The highest heuristic value route is picked. If the Emin > threshold is this direction, it will be picked. Otherwise, you select the route with the highest heuristic value

Emin = Eavg /const (1.5)

The constant may have an integer value such as 10 if const is constant. If Emin has no node above threshold energy in the routing table, it selects the node with the highest minimum energy. The last procedure in the EAMMH Protocol is a periodic update, which after a short time will stop providing information on pathways and routing table entries for each node. Based on the incorrect details, heuristic values frequently lead to wrong decisions. Therefore, fresh information should be regularly given for the nodes. This will make the heuristic method more reliable and timely. The required information is shared at regular intervals during the process of each round. The interval of daily updates is wisely chosen so that the node does not base its decisions on the inaccuracy of information but does also not overwhelm the network activity in the periodic updating. .[21][23][11]

IV. SIMULATION & RESULTS

MATLAB simulates both LEACH and EAMMH. In determining EAMMH and LEACH, the parameters considered are as follows:

• Round number v / s Dead Nodes number (with probability variations)
• Average Node Energy v / s round number (with probability variations)
• Round number v / s Dead Nodes number (with node number variations)
• Round number v / s Average Node Energy (with node number variation). The results below display the simulation of both the LEACH and the EAMMH protocols at 0,01 chance, which is 1 % of the total nodes that can be cluster led.

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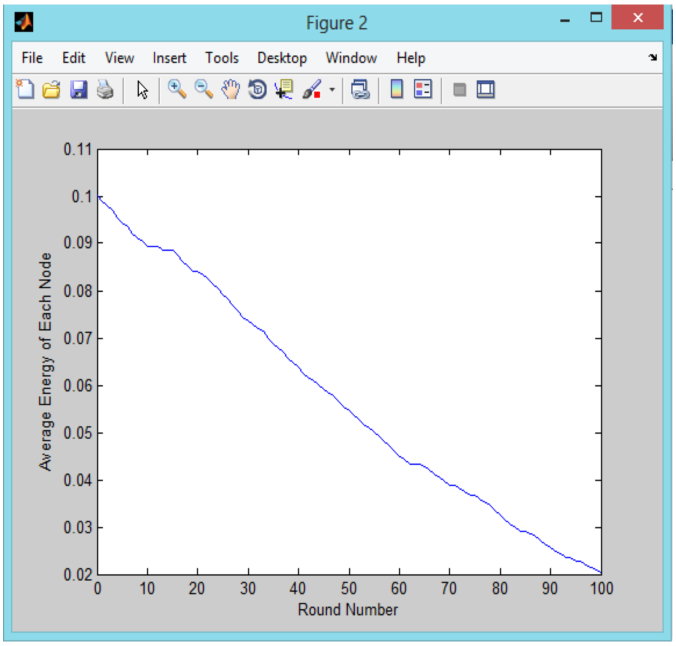

Figure 4.1 Average Energy v/s Round No. (EAMMH)

Figures demonstrate that as the round becomes longer, LEACH and EAMMH improvement both lose energy. When a node's value drops to 0, it is frequently considered to be dead and no longer available. According to data, the EAMMH curve performs marginally better for the average power of each node as the number of nodes increases. In comparison to LEACH, there are also fewer dead nodes, but there are more nodes overall. Therefore, as the number of nodes rises, EAMMH performs better than LEACH for a probability of 0.01. It is clear that the average energy of each node and the overall number of dead nodes at each probability level have an impact on the number of EAMMH nodes. LEACH's performance has increased, however for fewer total nodes. Statistics reveal that even though EAMMH is more powerful, most operations have an EAMMH first dead node. LEACH takes longer to detect the initial dead node, but in a shorter amount of time, more knots will become helpless. According to statistics, if the probability of choosing the Cluster head increases, the average energy of each node's distance from the curves falls for a certain number of nodes. We see that.

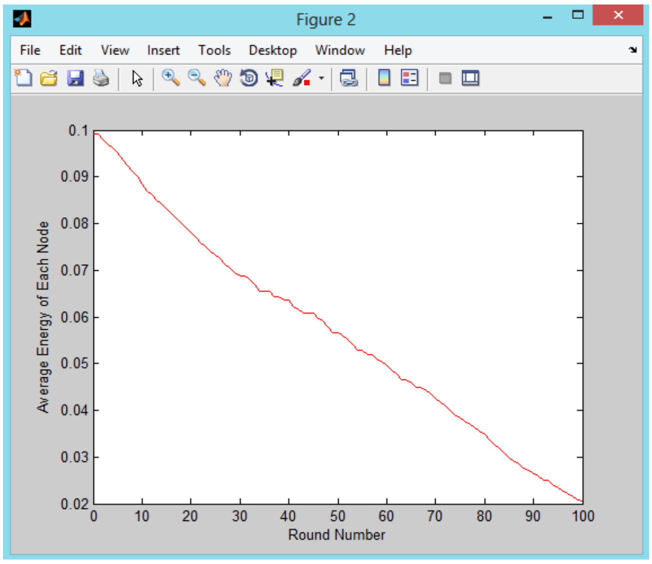

Figure 4.2 Average Energy v/s Round No. (LEACH)

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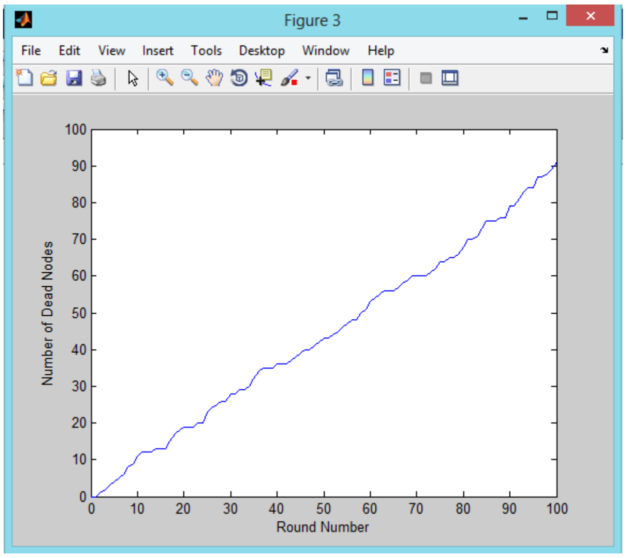

Figure 4.3 No. of Dead Nodes v/s Round No. (EAMMH)

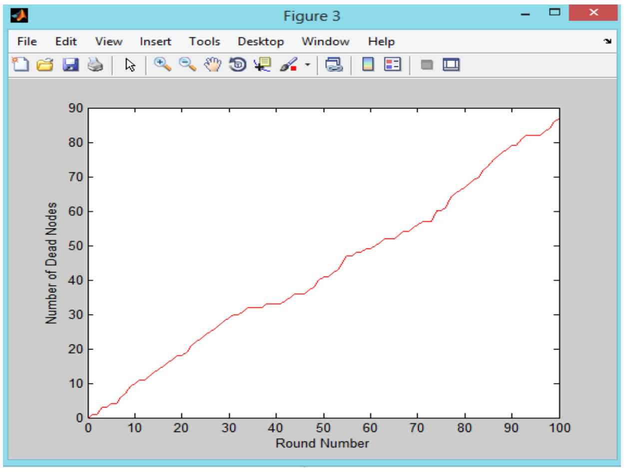

Figure 4.4 No. of Dead Nodes v/s Round No. (LEACH)

LEACH outperforms EAMMH at 0.01 probability, EAMMH outperforms LEACh by a factor of around 25% at 0.5 probability, and by a factor of about 46% at 0.2 probability This is due to the fact that nodes or clusters more away from the base station must travel farther to transfer data than those closer to it, which forces them to expend a lot of energy. This is due to the fact that Eammh is an intercluster routing device, which in most situations helps the network live longer than LEACH. The only action it takes is eammh. However, LEACH connects first with the cluster head before moving on to the base station. Although the business employs multi-hop systems, EAMMH can outperform LEACH in terms of energy efficiency by utilizing multi-way and hierarchical routing settings and methodologies. network.

V. CONCLUSION

Wireless sensor networks are frequently scattered over vast regions. There is a need in this area for techniques that can handle the WSN more effectively. The wireless sensor networks employ the limited battery capacity. Given the limited capacity of the sensor nodes, the main difficulty in building Wireless Sensor Network protocols is energy efficiency. Every routing protocol's final driving force is to make the network run as long and as energy-efficiently as feasible. In this study, we proposed clustering as a solution to this energy efficiency issue. There is a detailed discussion of the two protocols, LEACH and EAMMH, accessible. Discussions have also included information about the simulation and its conclusions. LEACH may be employed in smaller grids with less than 50 nodes overall, where it performs somewhat better than EAMMH and EAMMH, and in bigger grids where the heuristic likelihood of choosing Cluster Head is higher, according to the simulation's brief study.

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