Lossless Routing Protocol Pertaining To Heterogeneous Wireless Sensors Network

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ABSTRACT
Low power issues in wireless sensor networks and power source restrictions need maintaining energy issues. Lessening the energy consumption of sensor networks is a common goal of many investigations. In addition, it increases network scalability and lifespan. Routing protocols should be built to adapt to diverse wireless sensor networks' features. With master, advance, and normal nodes, this research proposes a novel LEACH-Dependent clusters strategy for heterogeneous wireless sensors networks In order to address heterogeneity, LEACH (MAN-LEACH) has been redesigned. With HUMAN-LEACH, head of Cluster are chosen based on remaining energy of every node in network with its normal energy. Nodes' probability of becoming Head of cluster depend on their remaining energy. To transport packets across the network, MAN-LEACH offered three levels of energy amplification: low, medium, high. With MAN-LEACH, you get the best lifespan, average residual energy rate, and packet transfer rate compared to the other two protocols LEACH and MOD-LEACH.

Keywords: Heterogeneous, WSN, LEACH, Energy efficient routing protocols, Residual energy, MAN-LEACH.

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I. INTRODUCTION

Due to its theoretically extensive area of use, the Wireless Sensor Network has become a significant research field. The WSN is made up of thousands of smaller nodes, each with its limited capabilities, which together can create a useful network for a range of applications, including emergency response, fire detection, vehicle tracking and habitat monitoring. Any feasible communication way to the destination or sinks by hopping data

from node to node is identified for the meshed network connectivity. This small sensor nodes consist of sensors, processing of data and communication elements. This sensor nodes have main characteristics of an infrastructure-free and self-ordering capabilities. Randomly spaced and unattended, the sensor nodes carry out their functions. Another key feature of the sensor network is communication between sensor nodes.

Processors in sensor nodes are on-board. The partly processing information is transmitted by calculation rather than the transmission of raw data sensor nodes. The WSN typically runs unattended after installation in the network region for each sensor node with a minimum power. With consumed energy, the sensor nodes start losing their energy and the node nearest to death stops all WSN operation. Therefore, maintaining the strength of the knots is one of the key shortcomings of the sensor network design. The power usage of the source of electricity is an important concept in the WSNs because of the limited power supply in the sensor nodes. When information is transmitted through sensor nodes to other nodes, maximum energy is exploited. A variety of investigations have been undertaken in order to establish routing algorithms to prolong the existence of the sensor network. The Wireless Sensor Networks have some distinct features relative to other kinds of wireless networks that impact network performance. Those functions such as node density are special in the algorithms and protocols of wireless sensor networks. It is very difficult to link sensor networks since they are distinct in several different respects from typical ad hoc networks and wireless networks. The networks are quite difficult. First, it is not possible to create a global management system for the implementation of pure sensor node numbers. Modern IP protocols for sensor network implementations cannot therefore be used. Secondly, in contrast to conventional communication networks, almost all sensor network architectures permit the flow of sensed data from various regions to a specific sink. Thirdly, data traffic is highly redundant since many sensors are capable of producing the same data almost like an anomaly. This redundancy is used by the routing protocols to maximize energy and bandwidth usage. Fourth, sensing nodes, which demand careful control of energy, are highly restricted in the field of transmission power, on-board power, bandwidth processing and storage. Notwithstanding these differences, a considerable number of new data routing algorithms have been proposed on sensor networks. The methods of routing have taken into account sensor nodes' properties, software and architectural requirements. Almost all routing protocols can be classified as data center or hierarchical, even if the flow of a network or the level of service depend upon a few different protocols. A research on the effect of heterogeneity in node potential is carried out in this study. It is thought that part of the population of nodes in the same network has more resources than other nodes and is thus a heterogeneous sensor network. The rationale for this work is that certain processes would significantly benefit from an understanding of the consequences of these heterogeneities. The nodes are energized rather than the nodes in use, and produce energy heterogeneity.

Many small nodes with self-organizing, short-range broadcast communication, and multi-hop routing make up wireless sensor networks (WSNs). These small nodes are put in faraway regions to monitor, acquire data, and communicate important data regarding particular processes intended in monitoring in concerned location. Depending on the application and goals, sensor nodes may be deployed evenly, randomly, or linearly.

Batteries are the main source of power in sensor networks, making energy consumption difficult. WSNs' main difficulty is power consumption. A sensor that has run out of power is difficult or impossible to replace. Additionally, radio implementations lowered sensor node energy. Thus, smart routing strategies may save energy and increase network lifespan in WSNs [1]. Many protocols exist to decrease power usage in WSNs. Data routing strategies used by these protocols include low duty cycle, contention, scheduling, and clustering. Cluster algorithms are one of the most widely used routing approaches in WSNs, since they increase scalability and extend network lifespan, respectively. Clustering mechanisms come in two flavours. Implemented in homogeneous networks with the same beginning energy and hardware capabilities [2] and heterogeneous networks with varying initial energy and hardware capabilities [3]

It is more likely that WSNs will be diverse than homogeneous because to the nature of radio transmission, random occurrences, and unsuccessfulness like short-span of connection failure and field characteristics features On other hand, whereas homogeneous based routing protocols operate well in homogeneous networks, they struggle to distribute energy equitably across nodes in heterogeneous networks, resulting in poor performance.

II. LITERATURE REVIEW

There is much study in the literature on energy-efficient WSN protocol clustering. Researches opined that a routing algorithm for homogeneous WSNs with LEACH clustering adaptation, with sensor nodes randomly calculated to be CHs and the unit power load shared with the WSN[4]. A new LEACH routing protocol is proposed[5] for energy optimisation. This algorithm is known by selecting cluster heads similarly, which is more efficient than the LEACH algorithm. A updated LEACH from the LEACH algorithm is given in the paper[6]. In[7], an improved, energy-efficient, portable sink algorithm has been developed compared to mod-LEACH and PEGASIS[8]. The revised Leach edition, LEACH-C, selects the cluster heads at a random level at the base station. Community heads could be all nodes with a higher energy content than an average. The base station runs a virtual ring algorithm to find the best solution for reducing cluster head energy in better locations[9]. M. Tripathi et.al implements the LEACH-C Energetic Efficient Protocol (EELEACH-C), which sorts the lower value of the cluster candidates head nodes sorted with their residual energy into a base station. After determining the candidates' cluster head nodes, it chooses the candidates with the largest residual energy, then computes the quadratic sum of distances from their nodes in order to find the optimum solution. The protocol suggested has been shown to increase network durability[10]. Q-LEACH technique, the sensor nodes on the territories are used and grouped into four quadrants for improved clustering. The whole network can be best protected by such partitioning. In addition, the precise distribution of nodes in the industry is well known. The network distribution in quadrants means that the sensor nodes are used effectively by capital. This division describes the optimum positions of CHs. The size of the clusters is arbitrary in typical LEACH clusters, and some members are distant. As this cluster is dynamically formed, more nodes suffer from high energy drainage and thus network efficiency degradation. Although the clusters are more deterministic in their structure in the QLEACH network and thus are sub-sectorally separated. Thus, the nodes are well spread within a certain cluster and help to drain resources efficiently. Instead, the LEACH distance-based method (DB-LEACH) proposes to look at the distance component from the threshold equation and the developments in energy conscious distance[11]. And, with a cross-layer architecture between Medium Access Control (MAC) and network layers, the Motive Nodes Cluster Centered Routing Protocol is proposed to minimize energy for mobility sensor knot[12]. This type of approach performs best in WSNs with mobile sensor nodes.

A typical WSN routing protocol is LEACH [13]. LEACH employs a TDMA/CDMA MAC to decrease collisions inside and across clusters. But data collection is cyclical. With the capacity to acquire and interpret data, LEACH nodes are randomly placed across the world. LEACH revenue is separated into two stages: setup and steady. However, it has various flaws, including a random selection of cluster heads in each cycle, which might lead to depletion of certain nodes [14].

This technique employs K-medoids focussed at cluster generation in ensuring consistent cluster formation. With respect to subsequent round, head of cluster are elected through selecting closest node to the previous round's cluster head as the current cluster.

For example, in En-LEACH [15], a node with greatest energies which recent head of cluster is chosen acting as a cluster's head in the first round. However, En-LEACH is designed for homogeneous networks and performs poorly in heterogeneous networks due to its usage of multiple modes of energy to amplify transmitted signals. Due to the fact that all prior protocols assume homogenous sensor networks, their performance in heterogeneous networks is subpar. Each node present with network of Hierarchy having 2 networks of Heterogeneous combination containing multiple hop routings finds Better route amongst base station and cluster's head. In heterogeneous networks containing multi-levels, MS-LEACH performance degrades with low hop counts. Higher nodes of energy have higher chances getting chosen as clusters chiefs inside BEENISH network. It is based on the location centrality of nodes and first proposed in [16]. This enhances both energy efficiency and network longevity. There are 3 substrates of energies nodes in EECCCP protocol, usual, super, and advanced node, which form a topologies for cluster implemented within co-centric round fields of network.

Het-DEEC protocols [17] uses weighted election probability and threshold function to elect Cluster leaders and members. Cluster heads are more likely to emerge from Het-DEEC nodes with the greatest energy. This method increases the network's lifespan and energy. Protocol MAN-LEACH enhancement sends information based on proximity amongst receiver and transmitter based on original LEACH disadvantages. A novel approach to choose cluster head by building threshold Equation is presented in this paper. Depending on remaining energy of sensor network's nodes, Distributed Energy-efficient Clustering (DEEC) Algorithms [18], [19] proposes clustering approach cope having heterogeneity. For example, DEEC assumes that all nodes in the network have distinct beginning energies, and that each node has a different Probability to become a cluster leader at a certain round. Master, Advanced, and Normal Nodes (MAN-LEACH) are proposed as three levels of nodes in the proposed protocol. And use residual Energy in cluster head selection calculations [20].

III. METHODOLOGY

We define master nodes as nodes that are constructed with greater initial energy than regular nodes. Nodes with starting energy greater to usual node (a) number of amount are known to be developed nodes, whereas those having starting energy lower compared to usual node (b) multiple time are termed as normal node. Starting energies of master, advanced and normal nodes given as $E_M=E_a+\bar{a}E_a$, $E_A=E_a+aE_a$ and E_a respectively [1].

$$E_T = N(1-m)E_a+Nm(1-m_o)E_A+Nmm_oE_M \quad \text{Eq.1}$$

$$E_T = \sum_{i=1}^{N} E_i(r) \quad \text{Eq.2}$$

Because of (1) and (2), MAN-LEACH has more energy than original LEACH. Understanding how MAN-LEACH selects cluster heads requires knowledge of how LEACH selects cluster heads. In order to become a cluster head Equation.

$$p_{optimum} = 1/(n_i) \quad \text{Eq.3}$$

Where $p_{optimum}$ was optimised probability pertaining to (N) Nodes in transforming into cluster's head. Later LEACH nodes converts into cluster's head for each (I) n turns irrespective of changes in every node's residual Energy, entire nodes does not consist of same level of Residual energy once networks initiation of evolving process, as per nodes of LEACH consisting of least Energies eventually die-off quicker compared to having high levels as Energy does not get disbursed uniformly. LEACH exploits Equation (3) in evaluation of forecasting containing threshold's expression in selecting cluster's head. MAN-LEACH uses DEEC computation concerning Average probabilities, however suggested novel threshold in choosing cluster's head depicted subsequently, so, consider average Probability is represented using:

$$p_i = 1/(n_i) \qquad \text{Eq. 4}$$

Through considering network's residual energy:

$$P_i = p_{optimum}[E_i(r)/\bar{E}(r)] \qquad \text{Eq.5}$$

Probability of average shown in Equation. (5) deals with Nodes of heterogeneous having:
Assume every node consisting of identical average energies. In network need know entire energies of every network's nodes, which caused many issues, thus a technique to estimate average energy in network is necessary. Once owned by each node, it keeps the network alive. If energies are disbursed correctly, maximum nodes die-offs at similar instant of time, evident with simulations conducted. So, the average energy of (rth) round is:

$$\bar{E}(r) = \frac{E_T}{N}\left(1 - \frac{r}{R}\right) \qquad \text{Eq.6}$$

Where (R) is the network lifespan in rounds. As a result, every node in a network uses the same amount of energy in transmission. E(r) is computed using Eq. (8) and an idealised network lifespan. Given that entire nodes die-offs with exactly similar instant of timespan, (R) is taken as sum of turns out of network's start to its end. Defining E_{round} as the network's energy waste per round (R).

$$R = E_T/E_{round} \qquad \text{Eq. 7}$$

$T(s_i) = p*(p_i/p_{optimum})/(1-p(r \bmod 1/p))$ *for* $S_i \epsilon G$; and T=0 in all other cases.

Then, in MAN-LEACH, the cluster heads are chosen depending on likelihood of remaining energies of every node post turns vs estimated network's average energies. MAN-LEACH adapts rotating time concerning each node to its own energy, i.e. As illustrated in Figure 1 of the MAN-LEACH flow chart, the higher initial or residual nodes of energy are most likely to become cluster's heads. According to simulation findings, MAN-LEACH may extend network lifespan and distribute energy so that every individual node die-off at exactly identical timespan. Uncertainty over proximity amongst receiver and transmitter remains another issue with LEACH. Energetic conservation requires transmission protocols that define the appropriate amount of enhanced energy in communicating base stations or cluster leaders with nodes. Using the same amplification power level to send packets to the cluster head as to the network's furthest end or base station wastes energy. According to one suggested method, nodes determine the needed energy amplification for signal transmission via global network knowledge. Incomplete network topology routing is required to locate and calculate distances, resulting in an overflow of control information. Dual transmission power levels [14] is one of MOD-proposed LEACH's solutions to the aforesaid difficulties. MOD-LEACH defines three transmission modes in networks of clusters:

1. Intra clusters transmissions: entire cluster intercommunication.
2. Inter-clusters transmission: between-cluster transmission.
3. Transmission cluster head-base station

Using the least amount of energy for intra-cluster communications saves energy compared to inter-cluster connections. It also reduces packet loss ratio, collisions and/or signal interference. To send an amplified signal using single hop data transmission, MAN-LEACH proposed a multi transmitting power mode.

$$d_{M\text{-}C} = d_f/(3.5) \qquad \text{Eq.8}$$

Base station to furthest network node distance. A distance smaller than threshold is used for the two lower tiers ($d_{M\text{-}C}$).

MAN-LEACH adds another barrier. The distance between cluster heads is referred to as d_{C-C} in network Using:

$$d_{C-C} = d_f/(2.5) \qquad \text{Eq.9}$$

Otherwise, the intermediate level is used if the distance is less than or equal to threshold d_{C-B}. Extra level between cluster heads and base station using the following formula:

$$d_{C-B} = d_f/(1.5) \qquad \text{Eq.10}$$

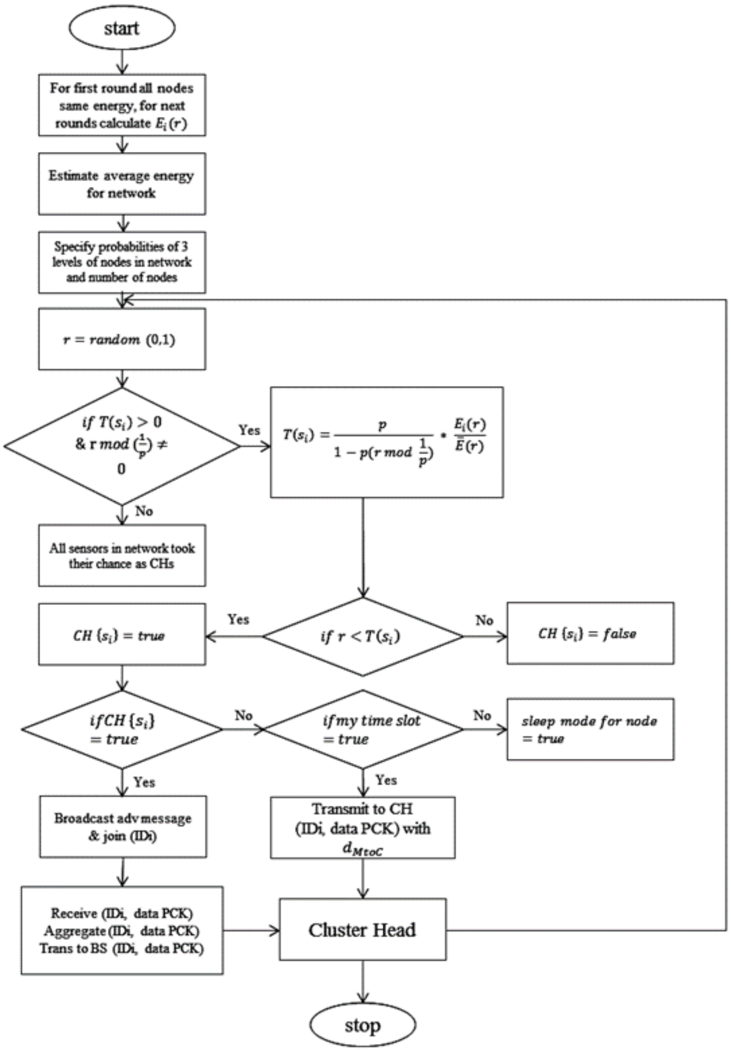

Figure1: Proposed work flowchart

Assuming that threshold is greater than d_{C-B}, the radio model employs an additional model to transport data between cluster heads and base stations. Radio dissipation model, Energy model of dissipation depicted with Fig. 2 are employed for study [15]. There were three models utilised in this model: 2-d, 4-d, and extra (with 6d power loss). So the radio extends to sends k-bit data messages received by base station from cluster's head.

Electronic energy (Eelec) depends on parameters including digital coding, modulation, filtering and signal spread. Simulator Parameters WSN environment with stationary base station in 100m x 100m field 100 nodes dispersed over the field The simulation time was set to 2000 rounds in Matlab. Actual MOD-LEACH, LEACH, MAN-LEACH and DEEC procedures were studied.

- Residual energy average
- Net throughput (packets sent to cluster head, base station)

IV. RESULT AND DISCUSSION

We simulated the design with the following outcomes and validated them against well-known published protocols: Nodes (live and dead). As shown in Figures 2, 3, MAN-LEACH outperforms DEEC, LEACH and MOD-LEACH and within terms of timespan extension of network (Figure 3). Its rounds were represented by x-axis and its nodes by Y-axis. MAN-initial LEACH's node dies at round 1400, whereas LEACH and MOD-all LEACH's nodes die before the simulation ends. As demonstrated, MAN-LEACH maintains more nodes alive than DEEC and is suitable for long-term applications.

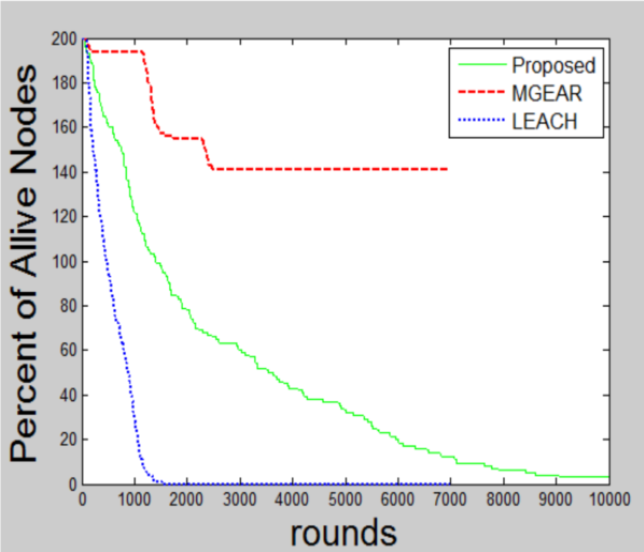

Figure2: Alive nodes through rounds

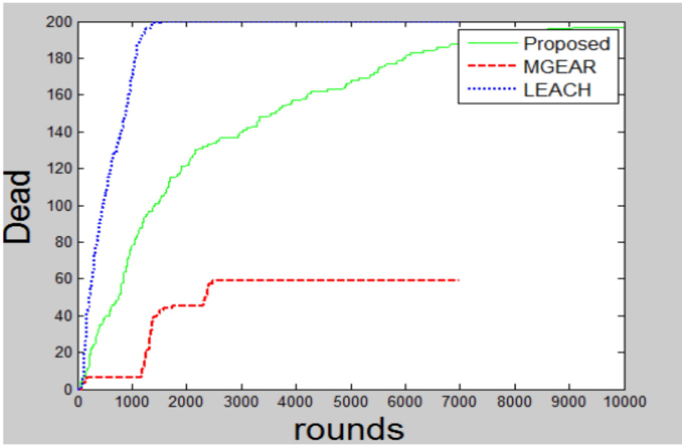

Figure3: Dead nodes through rounds

Figure 4 illustrates the network's average residual energy. This is the average residual energy value in joules after each simulation round (X-axis). LEACH and MOD-LEACH residual energies start off high and gradually diminish as the treatment progresses. It is important to note that MAN-LEACH outperforms DEEC in many ways. For computing signals received while re-routing these for base stations, cluster heads need more energy, whereas nodes of members use minimum energy to sense information with sending them towards cluster's heads at small distances. Thus, MAN LEACH saves energy better.

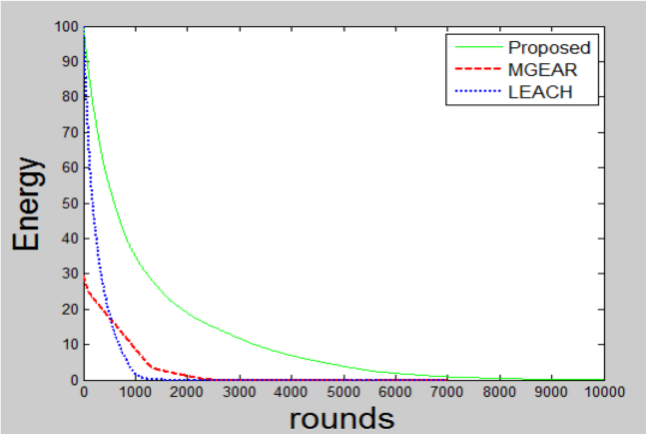

Figure4: Residual Energy vs rounds

Depicted evidently through Figure 5, X axis shows simulated rounds whereas Y axis depicts packets sent each round to the base station in bits (X = simulated rounds). Data acquired from member nodes and sent to cluster leaders are included in the total traffic. Due to MAN LEACH phenomenon for creating clusters and evenly disbursement of detecting information and routing jobs, DEEC performance exceeds MAN-LEACH performance by a narrow margin .

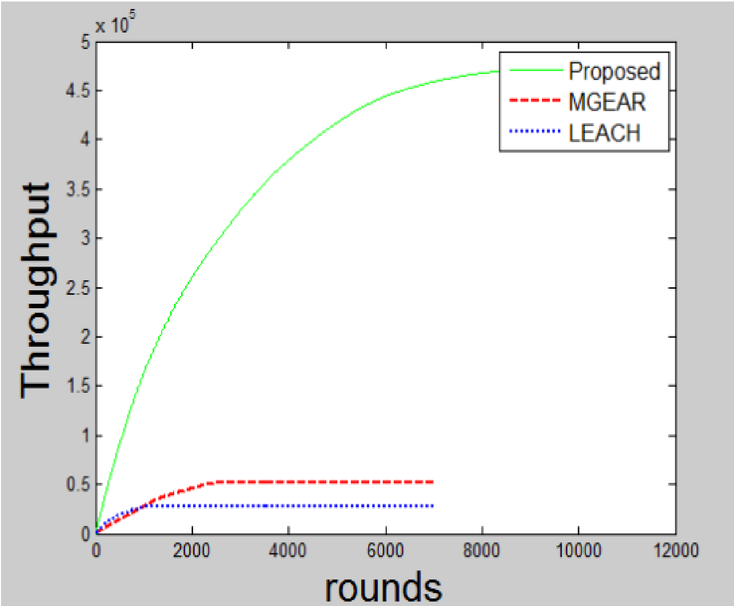

Figure5. Overall network throughput

V. CONCLUSION

By improving network stability and efficiency, we present the MAN-LEACH protocol, an energy-aware clustering routing system. To send packets in MAN-LEACH, nodes elect themselves as cluster heads. It outperforms original DEEC, LEACH and MOD-LEACH, in terms of extending network lifespan time, increasing average energy, and transferring packets to the base station. As shown by the findings, MAN-LEACH is a good choice for long-term applications that demand frequent reporting. Networks with several levels of heterogeneity and many levels of energy dissipation are enabled by MAN-LEACH. However, many protocols of clusters obstain from considering security concerns within its processes.

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