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ENERGY EFFICIENT CLUSTER HEAD SELECTION APPROACH IN WIRELESS SENSOR NETWORK

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ABSTRACT

Wide range usage of wireless sensor network in different fields is considered as important research area in these days. The development in electronic communications leads to develop a multi-purpose sensor node with low power consumption and cost. Wireless sensor systems are comprising of limited power sensors and it is difficult to recharge or replaced the sensors battery. Therefore, lifetime of wireless sensor networks is less due to more power consumption. Thus, the routing protocols that consume less amount of energy are desirable. For this purpose, various routing algorithms are proposed. The protocols based on clustering technique results low power consumption. Since radio communication consumes large amount of energy. The energy is an essential factor to be investigated. Thus, the power saving is a key issue in wireless sensor networks. Ongoing research involves designing routing protocols that requires less energy during communication thereby extending the networks lifetime. A comparison between LEACH and MODLEACH is carried out using MATLAB. Selection of efficient cluster head through which network lifetime is increased and reduces the energy consumption is a research issue.

KEYWORDS: Cluster, Cluster Head, LEACH, MODLEACH, Sensor, Wireless Sensor Network, WSNs.

I. INTRODUCTION

The development of wireless communication has empowered the improvement of infrastructure consists of computation, sensing and communication units that make administrator capable of observing and reacting to sensations in a certain situation. Such set-up involved hundreds or thousands of a little ease, multifunctional devices and low range handsets known as sensor nodes. These nodes forming a network called WSN as shown in Figure 1.1(Kumar et al., 2009).

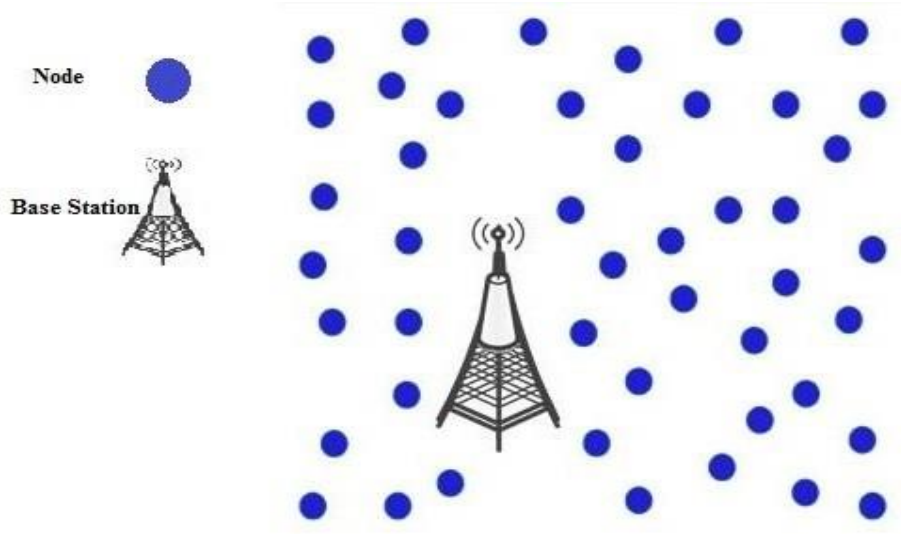

Figure 1.1: Wireless Sensor Networks (Kumar et al., 2009)

WSNs are designed for several purposes in the vast range of important applications such as health care, environmental monitoring, human administrations, and military applications. Typically, nodes in such situations are deploy to get sensed data for accurate monitoring. WSN incorporates a massive number of sensors set up in a region of interest. These sensors gather information and subsequently communicate the data packets to the base station (sink). Wireless Sensor Network (WSNs) consists of independent sensors, communicating with each other to observe the environment. A primary issue in the development of routing protocols for wireless sensor systems is the successful usage of power and increase the network lifetime. Energy saving in the WSN is the most significant problem.

All nodes are charged with a limited amount of power, which is hard to change or refresh due to the inherent nature and sorts of applications for which WSNs is used. However, energy proficient routing protocols for WSNs is the area that has become the attention for researcher to design Energy Efficient Routing (EER) protocols schemes (Rahman et al., 2013). Routing protocols are classify based on the network infrastructure, topology schemes, communication scheme, and reliable routing schemes (Rahman et al., 2013). The Energy Efficient Routing (EER) protocols for WSNs are categorized below.

1.1 Data Relaying Protocols

These protocols are straightforward in nature. These protocols are simply to execute. Data relaying protocols do not maintain any routing table nor do these protocols require keeping up topology data of the system. Some big data relaying protocols are Gossiping (Hedetniemi et al., 1988), Flossiping (Zhang & Cheng 2004) and L Gossiping (Kheiri et al.,2009).

1.2 Data-Centric Protocols

In data-centric protocols of WSNs worldwide addressing, the strategy is not practical due to the massive number of sensors. Therefore, each node needs to communicate information to the base station that brings enormous repetition in the transmission of information that causes significant power wastage. Hence, routing schemes have been designed that can choose an arrangement of sensor nodes in view of an inquiry-driven model and are additionally ready to gather information called Data-Centric Routing. Data Centric protocols are Sensor Protocol for Information via Negotiation (SPIN) (Heinzelman et al.,1999), Modified SPIN (MSPIN) (Rehena et al., 2011) and Direct Diffusion (DD) (Intanagonwiwat et al.,2000).

1.3 Location-Based or Geographical Protocols

Location-based protocols depend on the position of the sensor to choose best power efficient way between a sender node and a sink. Geographical protocols are typically made accessible to the sensor by the utilisation of GPS gadgets as it provides extremely precise location data, yet forces an additional cost for each node (Elrahim et al.,2010). Popular Location-Based protocols are Geographic Adaptive Fidelity (GAF) (Xuet al.,2001), Geographical Energy Aware Routing (GEAR) (Yu et al.,2001) and Location Based Energy-Efficient Reliable Routing Protocol (LEAR) (Alasem et al.,2011).

1.4 Mobility-Based Protocols

In many applications of WSN, the sensor nodes are static. However, sometimes nodes need to move in order to provide wider coverage and provide higher connectivity. It is useful to use mobility feature in nodes, due to which the network topology is change frequently. However, the BS in WSNs may likewise be portable putting substantially more difficulties to the issue of information directing. Along these lines, the Mobility-based protocols should be designed, thinking about the portability and normality for the nodes and to the sink. Some of the popular mobility-based protocols are Energy Aware Geographic Routing Protocol (EAGRP) (Elrahim et al., 2011) and Line-based Data Dissemination (LBDD) (Hamida et al., 2008).

1.5 Heterogeneous Protocols

In many WSNs, the sensor nodes initially have an equivalent energy, and every one of the nodes expands power at a similar rate in this manner shaping a homogeneous system. WSN consists of heterogeneous sensor nodes that have distinctive equipment attributes to perform various goals. The sensor nodes may have the different initial power to save subsequently forming a heterogeneous network. The heterogeneous protocols are Energy-Efficient Cluster Head Election Protocol (EECHE) (Kumar et al

2009) and Stable Election Protocol (SEP) (Smarag dakis et al.,2004).

1.6 Hierarchical or Clustering Based Protocols

A network with single gateway cannot scale well when network consists large number of sensors. Because of large number of sensor nodes, the single gateway is overloaded with huge amount of information. Thus, the entire WSNs is divided into a few groups (clusters) having numerous CHs. Each cluster consists a CH that is in-charge of information gathering as well as for information compression before transmitting the information to the sink (Rahman et al., 2013).The popular clustering based protocols are Adaptive Periodic Threshold Sensitive Energy Efficient Sensor Network Protocol (APTEEN), Threshold Sensitive Energy Efficient Sensor Network Protocol (TEEN) (Manjeshwar & Agarwal, 2001), Power-Efficient Gathering in Sensor Information Systems (PEGASIS) (Lindsey & Raghavendra, 2002) and Low-Energy Adaptive Clustering Hierarchy (LEACH) (Heinzelman et al., 2000).

1.7 Clustering-Based Routing Protocols in WSNs

In WSN, gathering of sensor into a group is known as clustering as shown in figure 1.2. Each Cluster consists of a pioneer named Cluster Head (CH). A CH might be chosen by the nodes of the cluster. A CH gathers the data from the nodes inside the cluster and sends this data to the sink (destination). Clustering can be utilised as a power efficient routing protocol. The most important point of clustering is to limit the aggregate transmission control amassed over the sensor in the chosen way and to adjust the load among the nodes for developing the system lifetime (Al-Karaki et al.,2004).

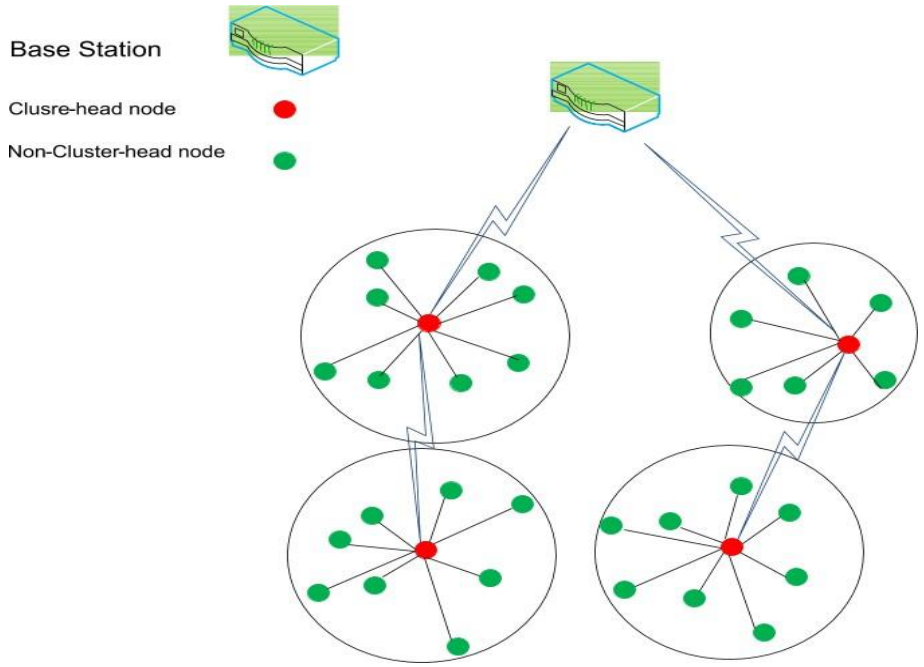

Figure 1.2: Clustering-Based Routing Protocols in WSNs (Heinzelman et al., 2000)

The basic point behind the development of the Clustering based routing protocol is to maximise the network duration and to minimise the power consumption. The usage of

the cluster is to communicate information to the sink and the benefits of lesser communication paths for maximum nodes. Therefore, only need a few nodes to cover the distance to the sink effectively.

$$T(n) = (P / 1 - P * (r \bmod 1/P) ; \text{if } n \varepsilon G = 0 : \quad (1.1)$$

1.1.1 Low Energy Adaptive Clustering Hierarchy (LEACH)

LEACH protocol works by hierarchical or clustering based routing protocol. At the point, when in the WSNs the number of nodes increases, then it is very hard to keep up the system with a single sensor node. Therefore, the Hierarchical or Clustering based protocols divide the entire sensor network into the group of nodes (commonly called cluster) and one node is selected as a Cluster Head (CH) from each cluster. In LEACH protocol, CHs are picked randomly based on the threshold value. Subsequently, the selection of cluster heads, several non-cluster nodes picked its CH in light of its separations.

The existing LEACH protocols select a cluster head based on the following threshold Where P indicates the preferred proportion of nodes to be CHs, G is the set of sensor nodes that have not taken part in CH selection in previous 1=P rounds and represents the current round.

LEACH splits the entire WSNs into a few clusters each covering some cluster member and a cluster head. LEACH protocol expects to improve the power utilisation in wireless sensor network (Singhb et al., 2017). In LEACH protocol after the determination of cluster head (CH), all sensor communicates the information to the CH and CH pack the information and transfer it to the Sink.

LEACH algorithm(protocol) includes the following properties (Heinzelman et al.,2000):

a) Cluster-based
b) CH is selected randomly in each round
c) Cluster head is responsible for data aggregation
d) Sink receive data directly from the cluster head

II. RELATED WORK

The random selection of the cluster head causes different problems like network lifetime, QoS, energy consumption, routing overhead etc. in both homogenous and heterogeneous wireless sensor networks. In homogenous and heterogeneous WSN the random selection of cluster head (CH) may possibly selects the cluster head (CH) with less energy which could decrease the lifetime of a network. Randomly selection may select a node which are distant from the base station, such cluster head (CH) put burden on network due to which it will increase energy consumption, routing overhead, and minimum throughput. Selection of best cluster head through which we could extend the network lifetime, and reduce the power consumption is a research issue. In clustering protocols, sensor also uses equal amplification power to send data irrespective of

distance between sender and receiver. In LEACH, nodes transmit the data within the network with same amplification power. Less amplification powers required for intra cluster or inter cluster communication and CH to BS communication the amplification power required cannot be same.

LEACH selected the CH randomly and transmit data via single hop communication from CH to BS. This was the key drawback of LEACH. To overcome those issues, LEACH was improved and new protocol called EE-LEACH was proposed. EE-LEACH selects a CH and efficiently data aggregation process was done which saves a significant quantity of power. The simulation experiments indicated that the EE-LEACH performance was better than the existing energy-balanced routing LEACH Protocol and protocol (EBRP) using parameter of energy consumption, less end-to-end delay and better packet delivery ratio. It was proved that the proposed EE-LEACH improved the lifetime of the network (Arumugam and Ponnuchamy, 2015).

In WSNs, Sensors were charged with limited amount of energy, which their battery could not be refreshed or changed. Therefore, if the energy consumption in network decreased, as a result, the network lifetime increased. Therefore, the development of power efficient routing protocols was the need for wireless sensor networks. It was inspected that network lifetime was increased if the power consumption was reduced and as a result, the network maintenance cost was reduced as well. It was concluded that Hierarchical routing scheme was an effective technique that decreases the power consumption through information gathering and aggregation to decrease the packets number transmitted to the BS (Dehghani et al. 2015). Developing power efficient clustering protocol in WSN was the key issue. The lifetime of the network was increased using clustering based protocols.CH selection was the key issue in clustering protocols. Power efficient cluster scheme was proposed for WSNs. The simulation results showed energy consumption were better than the existing protocols (Chaubey and Patel, 2016).

WSN was developing region of study due to vulnerability of sensing information from not approachable areas. In WSN, sensor nodes have been set up for collecting data and communicate this data to BS. In the processing of WSN energy consumption and data aggregation were important issues. In their paper, a new approach was proposed for power consumption reduction and data management using dynamic clustering and prevention of repeated data communication over the network. Their method se checks sum mechanism for data redundancy checking and discard repeated information. The simulation result showed their approach provides better results than previous approaches (Daman et al. 2016). WSN consists of sensor nodes that were very much sensitive to power consumption. All the reliable operation was performed by the hierarchical protocols in the WSN, which saves power of the nodes in WSN. For the said purpose LEACH was develop as a basic routing protocol. In LEACH protocols, operation of the WSN was executed in two stages, namely setup stage and steady state stage. WSN was divided into clusters and the clusters formation was done in setup phase. The data communication was achieved in steady state phase. The cluster head

selection was take place in setup phase. CH required efficient amount of power to communicate the data to the BS. To overcome this problem, CH were changed in every round. Setup stage was executed again and again which cause wastage of power. Evaluation of the analyze the ratio of power necessary in setup stage as well as steady state phase. It was analyze that energy requirement of setup and steady phase was near about same. A new mechanism was introduced to lower the energy overhead (Jain et al. 2016). The Method of dynamic CH was proposed in order to solve the issue of unreasonable CH election. The network node power was balanced in two stages. The simulation indicates that the network lifetime was increased by 50% when compared with LEACH. Furthermore, the dynamic CH selection results were compared with DEEC, and lifetime of the network was increased by 30%. In addition, the survival time of the network were longer than that of adaptive energy optimized clustering algorithm and energy-balanced deterministic clustering algorithm (Jia et al. 2016).

PEGASIS were ideal chain-based protocol for increasing the time period of the network. In PEGASIS, every node links only with an adjacent neighbor, performing a chain, select a leader from the chain who gathers the information from the neighbors to be communicated to the sink. Thus, the average power consumed by each sensor per round was decreased and to lower the bandwidth requirement. Based on their observations, it has been concluded that in PEGASIS protocol the CH election procedure depends on residual energy and the threshold value. Once the CH selection process was completed, then the data transmission procedure takes place (Mahakud et al. 2016).

In WSN, all sensor nodes were powered by the limited amount of energy, which was hard to change or refresh due to the inherent nature and sorts of applications WSNs was used. In WSN, sensor communicates to one another in multi- hop manner. Nodes main task was to gather the information from the field and sent it to the BS via cluster head for evaluation. Load balancing in cluster-based routing protocols, nodes role were interchanged in every round. A new protocol RF-LEACH was proposed where division of WSN into cluster was done using RFCM and CH selection was based on fuzzy logic. The results of RF-LEACH showed better performance as compared to FCM LEACH, Fuzzy LEACH and LEACH, and in terms of throughput in a load balanced way and maximizing the network lifetime (Mondal et al. 2016). To maximize the network lifetime, a new algorithm called modified k-means (Mk-means) was proposed for clustering which consists of three cluster heads at the same time selected for each cluster. CHs use a load sharing mechanism to rotate its role as the active CH, which save residual power of the sensor, thereby maximizing the network performance. The results of the simulation indicated that the proposed scheme Mk-means (modified k-means) algorithm was performed better than existing clustering algorithms due to its unique multiple cluster head scheme (Periyasamy et al. 2016).

In WSNs, Sensors were composed of the limited amount of energy, which their battery could not be refreshed or changed. Therefore, if the energy consumption in network decreased, as a result, the network lifetime increased. The heterogeneity in homogeneous WSN routing protocols and the effect of traffic heterogeneity was

discussed. Heterogeneities in sensor computation, energy, and link were considered the research area. In heterogeneous WSN, the traffic generation ratio was not well address. In their research, traffic generation rate was considered. Analyses of well-known hierarchical clustering-based routing algorithm were examined. A new improved mechanism for selection of cluster head under the traffic heterogeneous setup was proposed. The existing commercial algorithms performance was enhanced (Sharma et al. 2016).

The technological developments in wireless communication draw the attention to the designing of small multifunctional, low- energy and low-cost sensor nodes in WSNs. The network layer handle with routing problems in sensor networks. Since an huge amount of energy consumes by radio communication, thus power was an important factor to be investigated. Power management was thus an underlying problem in WSNs. The energy was the most critical issue faced by WSNs. Sensors short of energy could no longer fulfil its role unless the sources of energy were reloaded. Wireless sensors that were run by ambient energy were a promising technology for various wireless sensor applications (Warrier et al. (2016).

Large variety of sensor nodes were randomly deployed in a region. Node was small in size with limited memory, constrained battery life, and limited processing energy. Due constrained power battery, WSN needs to develop a routing protocol that minimize the power consumption. In cluster base routing protocols, the role of CH was rotate in every round due to which the energy was equally balanced. Their research was focused on cluster base routing protocols. LEACH was used to improve its performance and extend the lifetime of WSN.A new protocol called Node Ranked–LEACH was introduced. The proposed routing protocol improved network performance in terms of lifetime based on node rank algorithm. Node rank algorithm based on both number of links and path cost among sensor to choose the CH of every cluster. A new proposed system overcomes the random process of selection. Evaluation showed that propose Node Ranked- LEACH performed better than LEACH using parameters energy consumption and lifetime of the network (Al-baz and El-Sayed, 2017).

Technological advancement in wireless communication draw the attention to the designing of small multifunctional, low energy and low-cost sensor nodes in WSNs. Due to the technological advancement, WSNs gains the attention of the researcher. Nodes were arranging a group called cluster and sense the information the environment where it was deployed. CH in a cluster received the information from cluster member and transmits the information to the BS. CH needs high power to communicate the information. LEACH Protocol was selected for this work and in which the CHs were selected based on threshold value (Krishnakumar and Anuratha ,2017). The proposed scheme increases the threshold function of LEACH with count of neighbor nodes metrics and distance improves better energy efficient function. CH chooses high power of amplification to enhance the network performance. The residual power and number of alive nodes based on distance metrics were compared with the existing model. The simulation result of the proposed methodology showed better performance than existing methodologies for WSNs. Protocol EECRP was design to improve the efficiency of the

network. Simulation results, EECRP showed better performance than LEACH-C, GEEC and LEACH. To prolong the network lifetime, EECRP was suited to network whose BS was located in the network. Successor of LEACH protocol was now offered in single hop and multi-hop scenarios. Many efforts were already been made associated to LEACH, and it was a good scheme for different researches in the area of WSNs to go over LEACH and its variations over the years. Singh et al. had argued and discussed 60 LEACH associated protocols covering single hop and multi-hop transmission. Furthermore, these protocols was been relatively inspected on various parameters like power effectiveness, overheads and scalability. It was marked that the various LEACH variants were an advancement over the basic LEACH protocol. A primary goal of any newly designed protocol in WSNs was energy efficiency apart from performance factors (Singh et al. 2017).

In short, many protocols measured the power consumption during cluster formation and cluster head selection process. In selection of cluster head, important factor are power and apart from this, scholars refers to numerous other metrics for it such as node density, mobility, and distance from BS, location of the nodes, optimum number of cluster head and energy harvesting nodes. In WSN, security is important aspect for WSN as its wide range of usage. The vast majority of the proposed protocols for safety in WSN are doing as such on the cost of power productivity as there is an exchange off among security and power execution. In recent years, deterministic clustering approaches have gained additional quality in WSN as they are additional reliable than probabilistic clustering approaches. Hence, it is difficult to boost each energy efficiency and security at constant time. However, the deterministic clustering methods increase the power consumption and complexity, as they work on various mechanism like compound based, weight-based, fuzzy-logic based, heuristic-based approaches. Researcher’s works on hierarchical protocols over the years. The majorities of the LEACH-related protocols are talk about and offer a promising change over regular LEACH. However, there are still much space for creating advantageous and effective LEACH variations. Moreover, the cluster creation in heterogeneous network should be measured as an essential problem due to changed processing and communication proficiencies. In view of the literature, obviously the plan of a reasonable LEACH variation relies upon the particular application and client's prerequisites.

III. PROPOSED MODIFIED LEACH (MODLEACH)

MODLEACH is used to select the cluster head using the probability and current energy of the sensor nodes in a WSNs. The probability is used to create an equal opportunity for each sensor node to become a cluster head in the whole network lifetime. The following algorithm represents the cluster head selection in MODLEACH.

Algorithm Name: MODIFIEDLEACH CLUSTERHEAD SELECTION

Input: {S_i, n, E_i, G_i}

Output: {Cluster Head (n)}

Let assume that assume a node is S_i, the number of nodes is n, the energy of the node is E and G is cluster head. The value of G_i is 1 if it is cluster head in previous rounds otherwise 0.

The number of node in a cluster is 'S_i'.

S_i= {S_1, S_2, S_3… S_i}

Step 1: for i=1 to n do

Step 2: Current energy of each node is E_i

If (E_i> 0) Then

Si = Alive Node.

End If

Step 3: Check the node whether it becomes cluster head for the first time or not

If (G_i < 1) Then

Si=Not selected as CH in previous round.

End If

Step 4: Threshold value for sensor node (S_i) is

$$T(i)= \frac{p}{1 - p * (r \bmod (\frac{1}{p}))} * E_{max}$$

End If

If (Max_Threshold < T_i) Then

Max_Threshold = T_i

End if

End for

Once the cluster head is selected, then operation of sensor devices with in WSNs is performed according to the following procedure.

- All nodes communicate information to the BS via CH.
- CH is responsible for data aggregation.
- CH are selected based on threshold value.

- Normal nodes and advance nodes are introduced.
- Not all nodes have the same specification i.e., initial energy level.
- Sensors are assigned maximum energy and different energy level at starting point.
- Source to Destination energy e of transmission depends on the distance.
- In a random manner, nodes are uniformly distributed in a region.

3.1 Cluster Head (CH) Selection

Cluster head (CH) are responsible for gathering (detecting) of information from the sensors inside the network and sent it to the sink. Cluster head aims to expands the network lifetime and reduce the power utilization. In the proposed scheme cluster head (CH) are selected based on the define threshold value. In wireless sensor network, cluster head (CH) are key nodes for a network. Cluster Heads are responsible for information transmission to the sink received by nodes.

The operations of MODLEACH are categorized into to two stages each in particular:
(i) A setup stage to sort out the system into groups, CH announcement, and communication plan establishment. In setup phase, MODLEACH select the CH based on the following equation 3.1 i.e.

$$T(n) = \frac{p}{1 - p * (r \bmod (\frac{1}{p}))} * E_{max} \qquad \text{if } n \in G=0 \qquad (3.1)$$

Where P is the desired percentage of CHs, ris the current round, G is the set of sensors that have not been CHs in the last rounds and $E_{max}$is the maximum power of the sensor.

$$\text{Where } E_{max}=E_{initial} - E_{dissipated} \qquad (3.2)$$

(ii) A steady state stage for information collection, transmission, and compression to the sink. These cluster heads change arbitrarily after some time keeping in mind the end goal to adjust the power of the system.

MODLEACH are totally distributed and needs no worldwide information of system. It minimizes the power consumption by:
a) Reducing the transmission cost
b) Turn-off non-cluster head nodes as much as possible
c) Select the CH based on threshold value

In MATLAB, three scenarios are configured before modification under default environment of MATLAB by varying number of nodes in each i.e. 50, 100 and 150 with 1 base station in the area of 800 m^2. All nodes have the different initial energy i.e. 0.5 and 1 joule. The total number of the cluster in each scenario are different and simulation round are 100. The node are heterogeneous i.e. normal nodes and advance

nodes. The routing protocol used in simulation is LEACH/MODLEACH. The parameters of which analysis are made as Energy consumption and Network lifetime.

Table 3.1: Simulation Parameters

S/No.	Parameters	Values
1	Network Size	800*800m^2
2	Initial Energy (Eo) of Normal Node	0.5 J
3	Initial Energy (Eo) of Advance Node	1 J
4	Number of BS	1 (Base Station)
5	BS Location	400*400m^2
6	Number of Clusters	Random
7	Number of Nodes	50,100,150
8	Total Number of Rounds (rmax)	100
9	Data Aggregation Energy	5nJ/bit
10	Amplification Energy (Cluster to BS)d≥do	E_{fs}=10pJ/bit/m^2
11	Amplification Energy (Cluster to BS)d≤do	E_{mp}=0.0013pJ/bit/m^2
12	Amplification Energy (Intra cluster communication)d≥d1	$E_{fs}/10=E_{fs1}$
13	Amplification Energy (Intra cluster communication) d≤d1	$E_{mp}/10=E_{mp1}$
14	Routing Protocol	LEACH/ Mod_LEACH
15	Performance Analysis Parameters	Energy Consumption Network Lifetime
16	Heterogeneity parameter i.e. Percentage of nodes that are advanced	m=0.5; a=1;

IV. RESULTS AND DISCUSSION

Wireless sensor network (WSN) is considered as an important and the most critical advances for the twenty-first century. Power utilization is an important and most critical research area of Wireless Sensor Networks (WSNs).The protocol that needs low power

is the requirement of WSNs. The study has evaluated the power efficiency and network lifetime of LEACH and MODLEACH for wireless sensor network (WSN).

MODLEACH picks sensor nodes with maximum power as CHs and rotate this job to divide the power among the sensors inside the system. In MODLEACH, the Cluster Heads compress the information received from member nodes and send combined packet to the BS so that the amount of packet is less that is communicated to the BS. In first scenario, 50 nodes are placed in a square region randomly of 800x800m^2. The sink is in the center of region with fixed position. The sensor nodes are heterogeneous in the network i.e. with different energy level. The node's location is fixed after deployed.

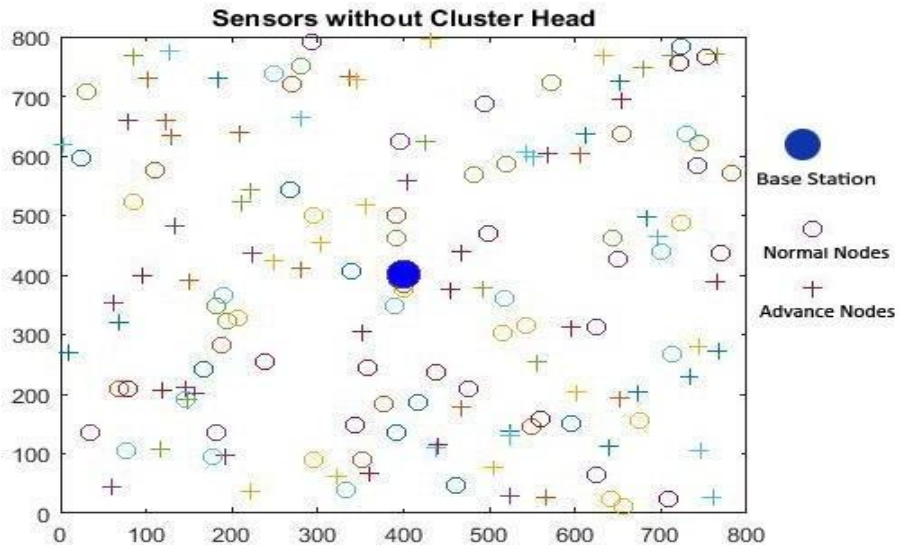

Figure 4.1: WSN without Cluster Head (CH)

4.1.1 Energy Consumption in Scenario of 50 Nodes

The energy consumption of MODLEACH protocol is examine with LEACH by choosing the number of nodes=50. The energy consumed in the network are calculated as total amount of energy used during transmission, the energy consumption of MODLEACH is always less than that of LEACH. The result is shown in the figure 4.2:

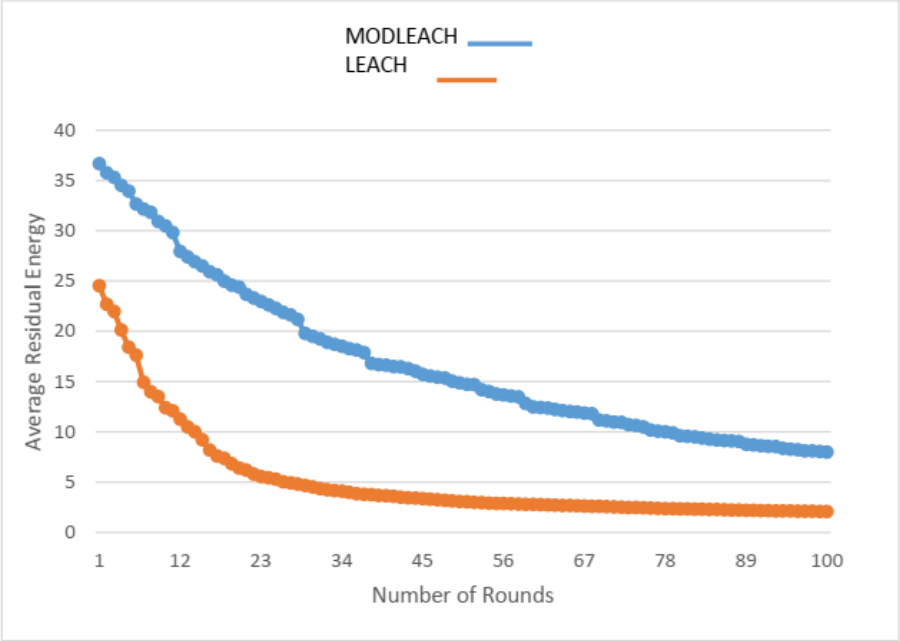

Figure 4.2: Average Residual Energy in Scenario of 50 Nodes

4.1.2 Network Lifetime in Scenario of 50 Nodes

It is clear from the figure 4.3 that the quantity of alive nodes in MODLEACH is greater than LEACH. The amount of sensor that is alive when each simulation is executed for both protocols.

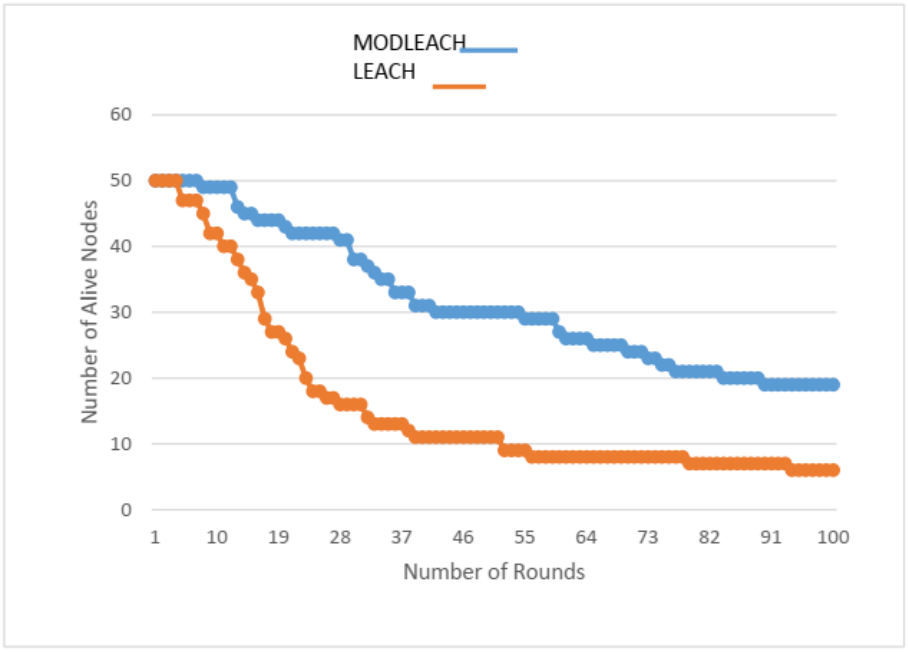

Figure 4.3: Network Life Time in Scenario of 50 Nodes

A node is declared alive when its energy becomes greater than zero and hence it can contribute to the network. It is concluded when MODLEACH and LEACH are examined as the number of alive nodes is greater in MODLEACH than that in LEACH. The sink is located at 400x400, keeping network size as 800x800. The outcomes are

shown in figure 4.3:

4.1.3 Energy Consumption in Scenario of 100 Nodes

It is clear from the figure 4.4 that the MODLEACH out performs than LEACH. The total amount of power consumed in 100 rounds are shown in figure 4.4:

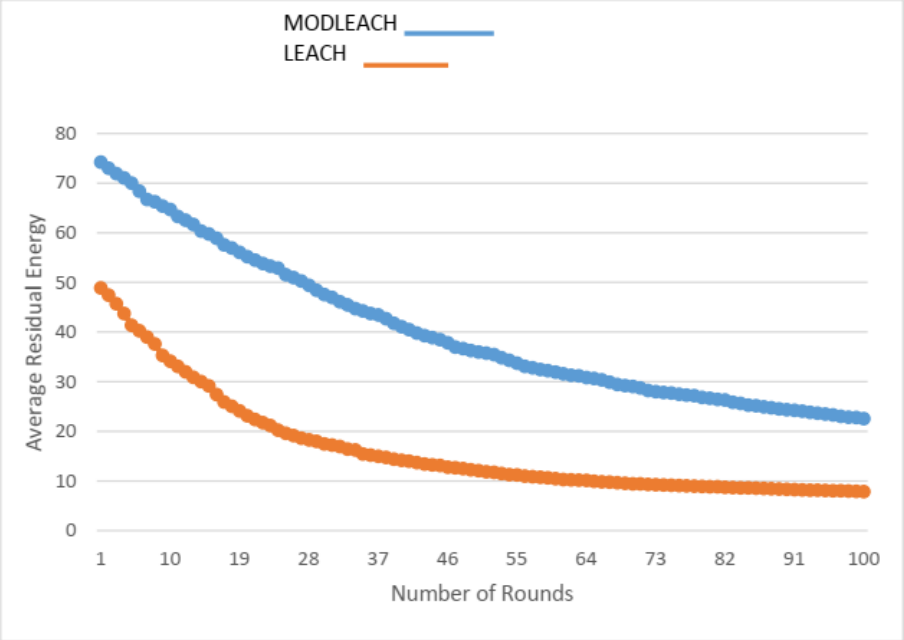

Figure 4.4: Average Residual Energy in Scenario of 100 Nodes

4.1.4 Network Lifetime in Scenario of 100 Nodes

It is clear from the figure 4.5 that the alive nodes in MODLEACH are greater than LEACH. It can be examining that MODLEACH improve the network lifetime when evaluated with LEACH. The result is shown in the figure 4.5:

4.1.5 Energy Consumption in Scenario of 150 Nodes

The energy consumption of MODLEACH is examine with LEACH by increasing the number of nodes i.e. node=150. The simulation result is given in the figure 4.6:

4.1.6 Network Lifetime in Scenario of 150 Nodes

The figure 4.7 shows that MODLEACH performance is better than LEACH. The alive node in LEACH is less than MODLEACH. A node is declared dead when its energy becomes less than zero and hence it cannot contribute to the network and if the energy of a node is greater than zero it is referred to alive node and hence can contribute to wireless sensor network. The figure 4.7 shows the result of the simulation:

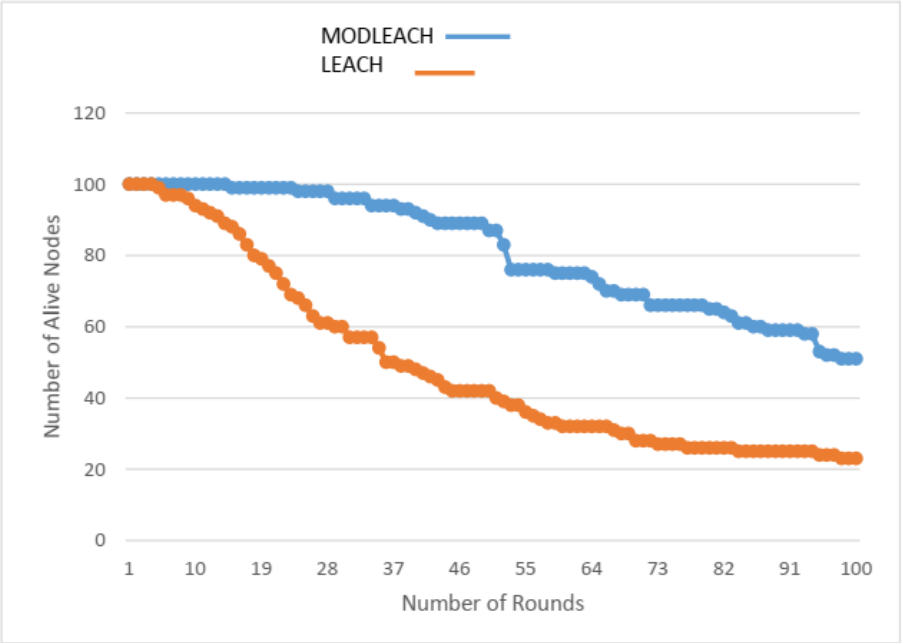

Figure 4.5: Network Life Time in Scenario of 100 Nodes

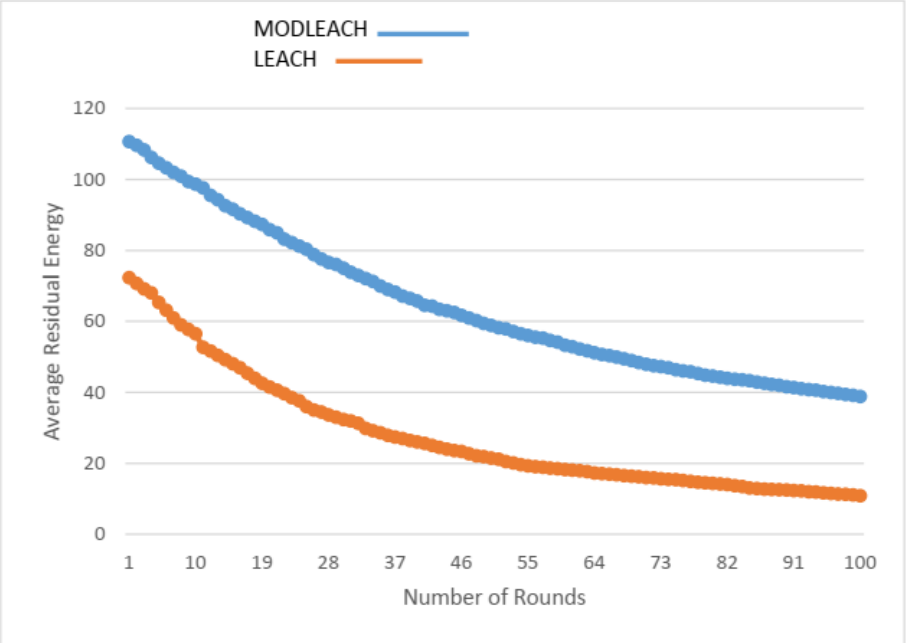

Figure 4.6: Average Residual Energy in in Scenario of 150 Nodes

The critical problems in sensor networks are most appropriate use of sources within the network. Since in those systems, commonly substitution of power supply and reusing of a sensor are not ease or are in conditions where there are no chance of replacing. Thus, sparing power utilization in every sensor will fundamentally decrease the cost of system support and builds lifetime of the system. Cluster based routing plan are a productive strategy that decrease the power usage through collection and information compression to lessen the number of messages sent to the sink (Dehghani et al., 2015).

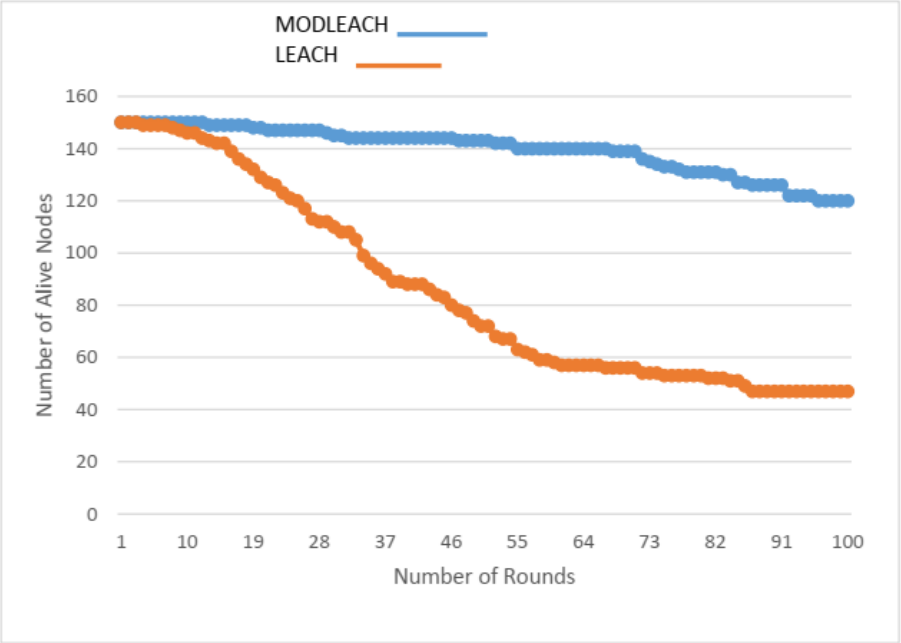

Figure 4.7: Number of Alive Nodes in in Scenario of 150 Nodes

LEACH is a hierarchical-based routing protocol that decreases power utilization by the network load among all nodes. LEACH performs static clustering algorithms and selects the cluster head with higher threshold value. Every sensor have the load of gaining information from the sensors in the cluster, combining the information to acquire a total flag, and transmitting this total flag to the sink. LEACH is totally appropriated and no central control is required from BS. Dividing the power among the sensor in the system is successful in reducing power dissemination from a worldwide point of view and upgrading network lifetime. (Heinzelman et al., 2000).

Simulations demonstrate that MODLEACH performs better considering measurements energy utilization and network lifetime w.r.t LEACH. From the outcomes, it is concluded that MODLEACH gives better results in energy effectiveness and expanding

V. CONCLUSION AND RECOMMENDATIONS

The research study finds that existing routing techniques, the hierarchical architecture provides a brief description about energy harvesting wireless sensor networks. Protocols designed should aim in keeping sensors alive for long period to fulfill the application requirements and should meet the scalability issues. This research study examines the proposed MODLEACH, which are power efficient routing technique for WSNs and contrasted to LEACH. The MODLEACH performs better than LEACH in terms of energy efficiency and network lifetime. MODLEACH performs better than LEACH as comparison is made based on average residual energy and network lifetime. The proficient CH selection with dual transmission control levels ought to measure in other clustering routing protocols of wireless sensor systems to view their effect in a more extensive sense. Other Parameters such as throughput and packets drop ratio should be determined for proper functionality of the MODLEACH over LEACH.

Energy consumption is the most critical research field of WSNs. It is necessary to propose protocols, which save high power, and give maximum throughput. In future, a protocol that has low power utilizations can be proposed and execute. It is yet an open issue that how to make cluster in heterogeneous sensor systems. This study recommends study of cluster head selection algorithm with various mobility speed.

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