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Detection of Wireless Sensor Networks using LEACH Protocol

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Abstract: ***Wireless Sensor Networks (WSN) resides of a large number of sensor nodes that are incomplete in energy, processing power and storage. LEACH is one of the most famous clustering mechanisms; it elects a cluster head (CH) created on a probability model. This paper improves LEACH protocol using CH-LEACH and DEEC. CH-Leach Protocol, an approach of algorithm proposed, this proposed research used number of connection in cluster, and for each cluster head (CH) communicate with base station, however the selection of the cluster head based on the number of cluster on the network gird area, this method allow the network to adopted the best scenario to extend life time of the network, different ways of cluster are formed, in order to avoid the condition that one cluster will contain large of connection nodes and the rest is not, the maximum number of the cluster head is chosen in different scenario to test the network coverage. A series of experiments on different scenarios were implemented and tested. The life time of the network in CH-Leach shows major extension compared to CH-Leach, DEEC protocols and proposed protocol. The main aim of this work was to design and implement a protocol which enhance exiting protocols in order extend the Life Time of Network.***
Keywords: LEACH, CH-LEACH, WSN, Network, data.

I. INTRODUCTION

Wireless sensor networks (WSNs) have been identified as one of the most important technologies for the 21st century. The tiny, low cost and low power sensors are able to communicate within a short range and work together to form a sensor network for gathering data from a field. [1]

These sensors have data processing and communication capabilities. They have also enabled us to monitor and collect data in any environment. They sense the conditions in which they are surrounded and transform their data to electronic signals. The electronic signals are transmitted over radio waves to the base station (BS). [2]

Processing such electronic signals reveals some valuable characteristics of that environment. The usefulness of WSNs is more noticeable when they are used in inaccessible areas since there is no need to adhere to a specific network structure. Another unique feature that represents a significant improvement over traditional networks is the cooperative effort of sensor nodes [3].

Raw data is collected by sensor nodes. Since the sensor nodes are equipped with an on-board processor, the raw data may be manipulated as desired. For instance, for a sensor node collecting temperature data the values retained may be limited to temperatures less than a certain threshold. As the main power source for all nodes is a battery, the energy supply for each sensor node is constrained. The primary goal in designing WSNs is maximizing network lifetime as it is impractical to change or replace exhausted batteries [4].

Such constraint necessitates energy awareness in designing WSNs. There are two competing objectives in the design of WSNs. The first objective is the capability to exchange large amount of data between the nodes and the base station. The second constraining objective is minimizing the energy consumption. The two competing objectives reveal the importance of efficient routing protocol in WSNs [4].

Therefore, many routing algorithms have been proposed due to the challenges in designing an energy efficient network. Among all the proposed methods, hierarchical routing protocols greatly satisfy the limitations and constraints in WSNs [5]. Hierarchical routing protocols, also known as cluster-based routing, is mainly considered as a two layer architecture where one layer is engaged in cluster head selection and the other layer is responsible for routing. A cluster head (CH) in hierarchical routing is the node which is responsible for collecting data from other nodes in the cluster, aggregating all data and sending the aggregated data to the base station [6].

A specific clustering protocol known as LEACH (Energy-efficient communication protocol for wireless micro sensor networks) is analyzed in this work. As part of this work, our analysis of LEACH leads to the development of a new energy-efficient protocol known as WEEC (A Weighted Energy Efficient Clustering for Wireless Sensor Networks) [7].

When working with a large amount of time varying data, another important issue that should be considered is the graphical representation of such data to aid in the visual identification of network behaviour. Energy consumption is central to this work and the energy level of each node in the WSN is of particular interest, since the energy level of each node is finite. An accurate and effective visualization tool would provide a quick and accessible means to view the energy level of each node in the field to support the development of routing algorithms that minimize energy consumption [7].

II. LITERATURE SURVEY

A brief literature review is needed in order to understand work done by various scholars in this field. As existence of shadows may cause serious problems while segmenting and tracking objects: shadows can cause object merging. For this reason, shadow detection is applied to locate the shadow regions and distinguish shadows from foreground objects. In some cases, shadow detection is also exploited to infer geometric properties of the objects causing the shadow ("shape from shadow" approaches). In spite of the different purposes, invariably the algorithms are the same and can extend to any of these applications.

Walid Abushiba et al. [2017] have been proposed CH-leach. We present architectures, schemes and evaluate. Its performance using analytical study and simulations. The evaluation was based on the most critical metrics in WSNs, such as: energy-efficiency (energy consumption), and network lifetime. The evaluation and comparison with existing solutions show that our proposed CH-leach exhibits a reduction in energy consumption over LEACH and DEEC. While the overall network lifetime of CH-leach is improved 91% and 43% more than LEACH and DEEC protocols respectively.

Sengamala Barani S. et.al. [2017] have been described the Wireless Sensor Networks (WSN) resides of a large number of sensor nodes that are incomplete in energy, processing power and storage. LEACH is one of the most famous clustering mechanisms; it elects a cluster head (CH) created on a probability model. This paper improves LEACH protocol using Fuzzy Logic (LEACH-FL), which takes battery level, distance and node density into consideration. The proposed method has been verified making a better selection by comparison models using Matlab. A wireless sensor network consists of three main mechanisms: nodes, gateways, and software [4].

Wei Xiang et al.[2016] have been studied Recent significant research on wireless sensor networks (WSNs) has led to the widespread adoption of software defined wireless sensor networks (SDWSNs), which can be reconfigured even after deployment. In this paper, they proposed an energy-efficient routing algorithm for SDWSNs. In this algorithm, to make the network to be functional, control nodes are selected to assign different tasks dynamically. The selection of control nodes is formulated as an NP-hard problem, taking into consideration of the residual energy of the nodes and the transmission distance. To tackle the NP-hard problem, an efficient particle swarm optimization (PSO) algorithm is proposed. Simulation results show that the proposed algorithm performs well over other comparative algorithms under various scenarios [25].

Gurbinder Singh Brar et al.[2016] have been described the directional transmission based energy aware routing protocol named as PDORP. The proposed protocol PDORP has the characteristics of both Power Efficient Gathering Sensor Information System (PEGASIS) and DSR routing protocols. In addition, hybridization of Genetic Algorithm (GA) and Bacterial Foraging Optimization (BFO) is applied to proposed routing protocol to identify energy efficient optimal paths. The performance analysis, comparison through a hybridization approach of the proposed routing protocol gives better result comprising less bit error rate, less delay, less energy consumption and better throughput which leads to better QoS and prolong the lifetime of the network [5].

Tushar Chauhan et.al.[2016] have been studied the Clustering is worn for the grille grows older and it is unrestrained notable passage in Liquor Ad hoc Networks. The capability faculty asseverate of each time pal-plug is singular in the bouquet. This putting right proposes a weighing of Eliminate and PEGASIS and Teeny-bopper obsequies which is planned to balance the sortie tiredness of the open up croaking and exaggerate the age of the offensive.[24]

Imane Boulhares et.al.[2016] have been studied Wireless Sensor Networks (WSNs) consist of small nodes with sensing, computation, and wireless communications capabilities. Hierarchical routing in wireless sensor networks (WSNs) is a very important topic that has been attracting the research community in the last decade. In our work, they proposed a set of hierarchical hybrid protocols between clustering-based LEACH-1R protocol and chain-based PEGASIS protocol, where we aim to enhance the lifetime of the network.[11]

Mohit Angurala et.al.[2016] have been studied Group of nodes organized in a cooperative manner is known as wireless sensor network. It can relay information between a computer and other devices by transmitting radio signals through the air. In this paper a review is presented of the routing protocols projected by wireless sensor network. There are number of routing protocols in a WSN. This paper also includes difference between two routing protocols. Routing protocols discovers and upholds routes inside network. In this paper we have compared various protocols in hierarchical routing.[16]

Saurav Ghosh et.al.[2016] have been studied Hierarchical routing protocols (HRP) like LEACH, PEGASIS disseminate data to the Base Station (BS) by assigning energy intensive data communication to high residual energy nodes while others are engaged in local communication with an overall objective of load balanced and energy efficient data routing. They propose a proactive HRP LEACH-DS-ACO by modifying the basic LEACH. LEACH-DS-ACO is simulated on MATLAB platform and its performance is compared with LEACH, LEACH-C and PEGASIS. Simulation results indicate that LEACH-DS-ACO outperforms the rest in terms of network lifetime and is also load balanced. The results are shown to be statistically significant.[19]

Lynda Mokdad et al. [2015] have been studied with development of wireless communications in the two last decades, new infrastructures had been developed. One of them was the Vehicular Ad hoc Networks (VANETs). Specifically on the Physical and MAC layers that are more vulnerable as they are built on distributed systems and a fluctuating radio channel. In this study, they proposed a new algorithm DJAVAN (solution of Detecting Jamming Attacks in Vehicle Ad Hoc Networks) to detect a jamming attack in VANETs using the Packet Delivery Ratio (PDR) and with the performance analysis, we determine the threshold that can make the difference between an attack and a poor radio link [17].

Baljinder Singh et al.[2015] have been discussed about a MANET is a collection of nodes that do not rely on a predefined infrastructure to keep the network connected Wireless sensor networks was being used in many applications like health monitoring, military purposes, and home automation. These networks were equipped with large number of sensors, which are spatially distributed. They were more vulnerable to attacks than wired networks. Wireless sensor networks suffer from various active and passive attacks. This paper reviews security issues on Ad-hoc network and Ad hoc On-Demand Distance Vector (AODV) protocol [21].

Ablolfazl Afsharzadeh Kazerooni et.al.[2015] have been studied Wireless sensor network consists of numerous small and low-cost sensors which collect and transmit environmental data. The sensor node is responsible for collecting data in regular intervals, converting the obtained data into electronic signals and transmitting data to sink node or base station through reliable wireless communications. Lifetime and network coverage are crucial factors in WSNs. Thus, particular algorithms must be employed so that energy consumption is reduced. In this paper two clustering algorithms, LEACH and HEED are investigated [15].

Abdul Rehman Khan et.al.[2015] have been studied three “Wireless Sensor Networks” protocols are being reviewed on the basis of their functioning. “Low Energy Adaptive Clustering Hierarchy” (LEACH), “Power-Efficient Gathering in Sensor Information System” (PEGASIS) and “Threshold Sensitive Energy Efficient Sensor Network” (TEEN) are some of the WSN protocols. Finally, we make a General analysis for the protocols with respect to the performance metrics and further create a generalized view and what the future scope of this paper stand to be. Thus, this paper will provide comparative study between three of Wireless Sensor Network's Protocols, LEACH, PEGASIS and TEEN.[1]

Ishu Sharma et.al.[2015] have been studied Routing algorithm decides which route will be followed by packets for communication between sender and receiver. Wireless Sensor Network consists of nodes with limited power source and low bandwidth. Optimal route for communication saves more amount of energy of the network. PEGASIS protocol is based on hierarchical network architecture proposed for Wireless Sensor Network. In this paper, PEGASIS is discussed and evaluated with simulator NS2 for performance issue.[12]

Sofiah.W.I. et al. [2014] have been described about Wireless sensor network and its applications are interesting researches that have been focused recently. In this study, the main primary and secondary cluster head are the important entities of the algorithm for receiving and transmitting data to the base station. The contribution of is mainly on the selection of a secondary cluster head and the routing protocol which the data transmission will involve the nearest cluster head for both tier one and tier two. Due to multi-tier clustering in sensor network, the operations of the sensor network will eventually increase the lifetime of the network compared to LEACH and SEP protocols [9].

Grover. A., et al. [2014] have been described the energy models to cluster based energy efficient routing in Wireless sensor networks (WSNs). Subsequently, several specialists have proposed distinct routing protocols for sensor networks, especially routing protocols depending on clustering scheme to minimize the energy utilization in wireless sensor network. This article presents a multi-tier multi-hop clustering scheme to reduce the energy consumption of wireless sensor network in which, multipath-AODV routing protocol is used to route the data from source to destination. In the demonstration of simulation results, as compare to LEACH the proposed algorithm provides higher performance and longer network lifetime [10].

Tripathi.A., et al.[2014] have been proposed about Wireless sensor networks (WSNs) consist of sensor nodes. These networks have huge application in habitat monitoring, disaster management, security and military, etc. Wireless sensor nodes are very small in size and have limited processing capability and very low battery power. This work focuses on summarizing various approaches used for the purpose of data aggregation and its various energy-efficient uses in WSN [23].

Dawood.M.Sheik. et al.[2012] have been studied use of wireless sensor networks has increased to monitor the disaster management, surveillance and industrial automation. Wireless sensor network (WSN) require a various power management protocols to reduce the energy consumption. Different cluster-based schemes are discussed as a solution for this problem. The surveys different clustering algorithms for WSNs; give emphasis to their purposes, characteristics, importance, complexity, etc. We also analyses these clustering algorithms based on metrics such as energy efficiency, cluster stability, location awareness, node mobility and QoS support [7].

Yuea.Jun., et al.[2012] have been proposed about wireless sensor networks, a clustering scheme is helpful in reducing the energy consumption by aggregating data at intermediate sensors. They propose a comprehensive energy consumption model for multi-tier clustered sensor networks, in which all the energy consumptions not only in the phase of data transmissions but also in the phase of cluster head rotations are taken into account. This algorithm is theoretically analyzed in terms of time complexity. Simulation results are provided to show that, the theoretically calculated energy consumption by the new model matches very well with the simulation results, and the energy consumption is indeed minimized at the optimal number of tiers in the multi-tier clustered wireless sensor networks [26].

Tharini C. et al.[2011] have been introduced the Wireless Sensor Networks have a wide range of applications including environmental monitoring. These networks consist of wireless sensor nodes which are densely deployed to provide a wider coverage area. In this paper an efficient data gathering approach is implemented by combining the dual prediction and clustering algorithm. Clustering algorithm based on spatial correlation is used to cluster the sensor nodes. Then within the cluster, the nodes send their data to the sink using the Normalized Least Mean Square dual prediction algorithm. Simulation results show that the proposed algorithm reduces the average energy consumption of the network [22].

Rahmani. N., et al.[2010] have been described the energy constraint is one the most important restrictions in wireless sensor networks so the issue of energy balancing is essential for prolonging the network lifetime. In this work we purpose the new clustering algorithm based on two-tier network topology namely CAT .The cluster head selection algorithm in CAT is done in two stages. So there will be two cluster head in a cluster. This algorithm selects a best sensor node as a cluster head in two phases by different methods. Simulation Results show the CAT prolongs the network lifetime about 45% and 19% compared to the LEACH and HEED, respectively [18].

Annoa J. et al. [2008] have been proposed sensor networks supported by recent technological advances in low power wireless communications along with silicon integration of various functionalities are emerging as a critically important computer class that enable novel and low cost applications. In this paper, in order to deal with this problem, we propose two fuzzy-based systems for cluster head selection in sensor networks. We call these systems: FCHS System and FCHS System. They evaluated the proposed systems by simulations and have shown that FCHS System make a good selection of the cluster head compared with FCHS System1 and another previous system [3].

Dehni .L. et al. [2006] have been described about the use of the wireless sensor networks (WSNs) should be increasing in different fields. However, the sensor's size is an important limitation in term of energetic autonomy, and thus of lifetime because battery must be very small. This is the reason why, today, research mainly carries on the energy management in the WSNs, taking into account communications, essentially. In this context, we compare different clustering methods used in the WSNs, particularly EECS, with an adaptive routing algorithm that we named LEA2C. This algorithm is based on topological self-organizing maps. We obtain important gains in term of energy and thus of network lifetime [8].

Singh P. et al. [2015] have proposed Wireless sensor network is a network consisting of various numbers of small nodes deployed in the remote areas to perform the task of sensing, computation and data forwarding. These sensor nodes keep on getting drained in the energy whenever the data transmission phase comes into action. To achieve a longer lifetime these nodes are dealt with various routing techniques which makes the communication between nodes and Base Station much more economical in terms of energy consumption.[21]

III. METHODOLOGY

In this section we discuss the network modeling and the proposed routing method DEEC, CH- LEACH and Hybrid routing Protocol in detail. We have created a network with randomly deployed nodes N. We have taken the area of 100 square meters. We have computed the distance d of all the nodes from their neighbors and we have compared their distance with the threshold th value of distance, so that they could be connected only when their distance is less than or equals to the threshold value. We have used this algorithm to make it sure that all the nodes are connected with a minimum distant value.

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A. Algorithm

1) Step 1: Create a Network creation with following

a) Network. height=100

b) Network. Width=100; N=Total_Nodes.

c) For each n′ in N

counter = 1;

x= rand (1, 1)*xm.

y = rand (1, 1)*ym.

Node. name (n) = counter; counter = counter + 1;

Endforeach

d) Cov_set = [ ]; //it would contain the limited area node.

for i =1 to N

cov_count=2;

for j=1: N

if (i! =j) // a node cannot compute distance to itself

d = √ ((CL (m).x-SN (i).x) ^2 + (CL (m).y-SN (i).y) ^2);

t= (p/ (1-p*(mod (rnd, 1/p))));

end if end for end for

Above algorithm describes the node deployment in the whole network. In proposed network 100*100 network development takes place with coverage set = 1.

2) Step 2: Find the path

a) For i=1: Network.Simulation.Rounds

b) Source=Initialize. Source;

c) Source.Id=Node.name (source); Path= [ ]; Pathelement=2; Path [1] =Source;

d) Source.Packet.count=100;

e) Destination.Id=Node.name (Destination);

f) Current_cov_set_source=cov_set (source.Id,:)dest_found=0; possible_nodes=[ ];

g) While (dest_found! =1)

h) For each all n in current_cov_set

If(x(all n)>xloc(Source.Id) && (x(all n)-xloc(Destination.Id) < 0

Possible_nodes [possiblenoedcount] = all n;

Possiblenodecount+=1;

Endif

i) Selection=possible node count*Random;

j) Selected_node=Possible_nodes [selection];

k) Possible_Nodes=[ ]; Path(Path element) = selected_Node

l) End

3) Step 3: Set the different energy.

4) Step 4: Apply the random election of normal and advance Node.

5) Step 5: Apply the counter to count the distance between nodes, clusters and Base station and apply distance formula to find the distance.

6) Step 6: Choose the multiple paths with energy

S(i).E=S(i).E- ((tx_energy)*(4000) + multipath*4000*(dist*dist*dist*dist));

7) Step 7: Apply the CH-LEACH , DEEC and Hybrid Routing Protocol for transmission of data from Base station to different nodes through BS.

8) Step8: Find the first dead, half dead and full dead nodes during transmission of data from BS to nodes and clusters.

9) Step 9: Calculation of Energy dissipated based on distance

if (distance>do)

S(i).E=S(i).E- ((ETX+EDA)*(4000) + Emp*4000*(distance*distance*distance*distance));

end

if (distance<=do)
S(i).E=S(i).E- ((ETX+EDA)*(4000) + Efs*4000*(distance * distance));
end
10) Step 10: Draw Varnoi diagram for network.
11) Step 11: if Step 2 to Step 9 is completed then
Calculate
Rho1 = (number of bit error)/ (total number of bit send)
Bit Error Rate = Rho1 +Em
p= N/R
N is the number of bits, and
R is the rate of transmission (say in bits per second)
Delay=abs(p +Em),
Remaining_Energy = ETx (k, d) = Eelec * k + Єamp *k * d2, d>1
ERx (k) = Eelec * k
Energy Consumption= mean(Remaining_Energy)+Em
and
Size of the packet= abs ((abc) +Em)*packet
Transmission time =datatxperiod*10
Throughput= (Size of the packet / Transmission time)
End

IV. RESULT &DISCUSSION

In this Chapter the different problems are faced and all these problems are resolved with different Objectives. The Complied result snap shorts are given below:

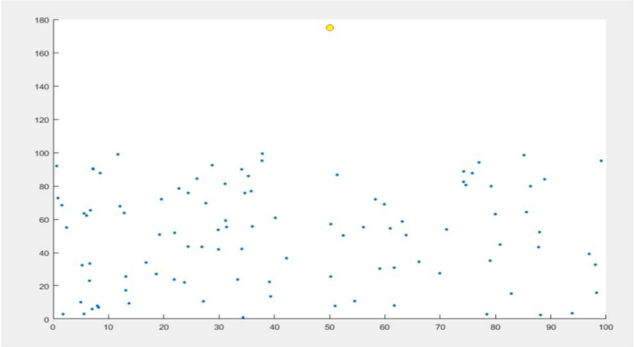

Figure 1: Deployment of sensor nodes

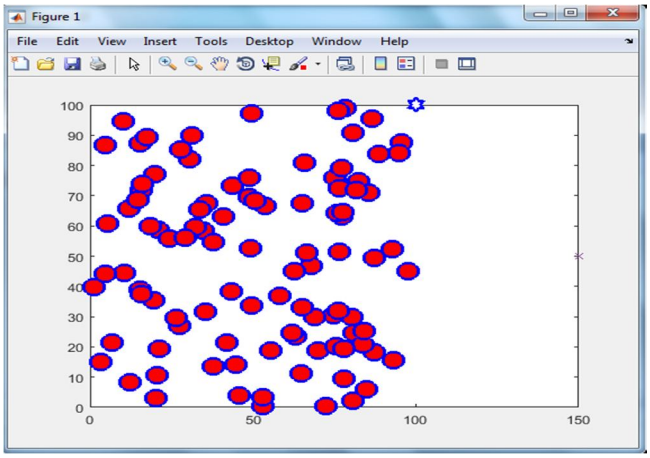

Figure 2: Nodes and Base Station on 100x100 areas

The figure 1 and figure 2 is the deployment of sensor nodes on wireless sensor network. In these figure nodes are displayed in red and blue color and base station is marked with yellow and white color. All these nodes are used to transfer the data through base station.

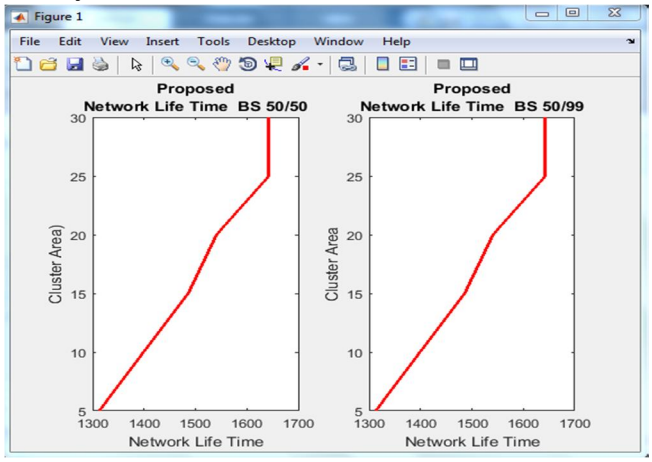

Figure 3: Network life time for 50/50 and 50/99 BS position

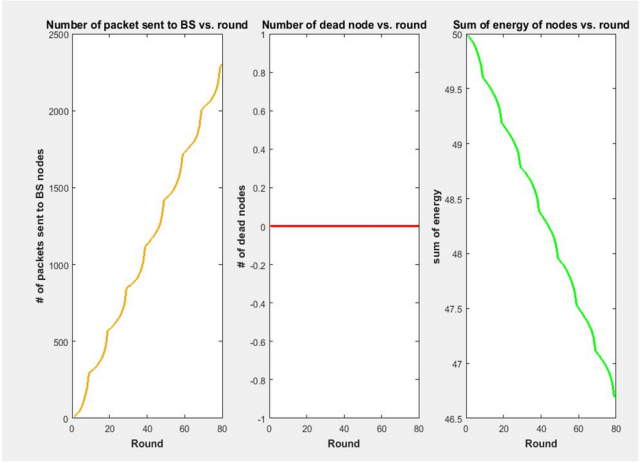

Figure 4: Packet to BS nodes vs. Round

The figure 3 is the representation of network life time with different position of Base station. In this figure the position of base station is 50/50 and 50/99. The graph is plotted between cluster area and network life time. The figure 4 is the representation of packet to Base station node vs. round. In this figure 3 graphs are plotted. The first graph is the number of packet sent to BS vs. number of rounds. The second graph is the Number of dead nodes vs. round and the third figure is Sum of energy of nodes vs. round. In this figure 1st the energy is high and then it is decreased , then the remaining energy is 45 joule.

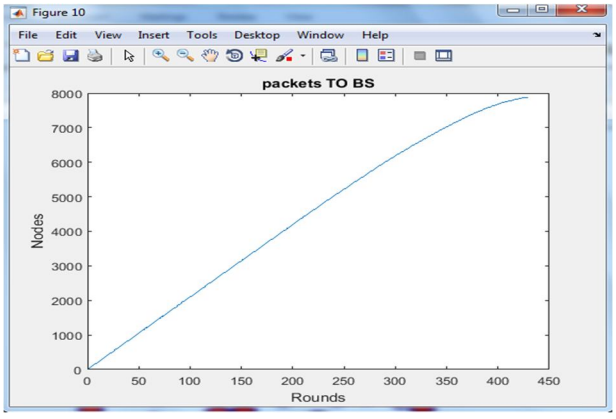

Figure 5: Nodes vs. Round

The figure 5 is the representation of packet to base station. In this figure nodes are represented on y-axis and the numbers of rounds are represented on x-axis. In this figure the packet are transferred on different round within different nodes. Initially the rounds value and nodes value is zero and then it is increased by every round and packet is transferred on every round and every node.

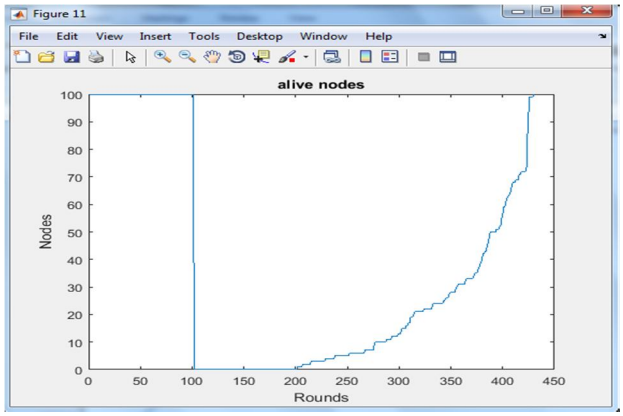

Figure 6: Alive Nodes vs. Round

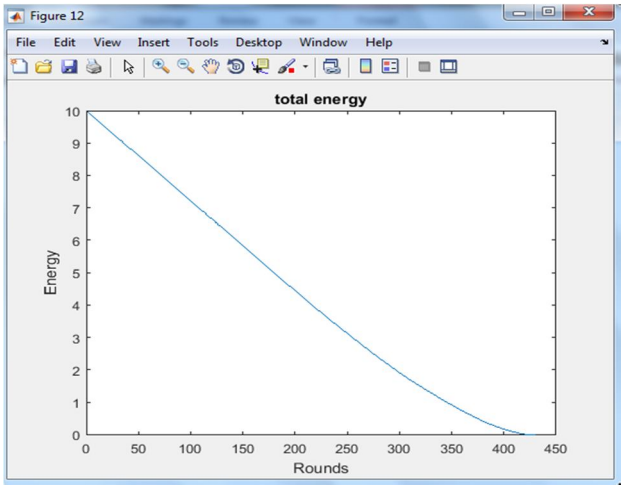

Figure 7: Total energy vs. Round

The figure 6 is the alive nodes on network with respect to round, because when energy is decreased then the nodes going to become dead. In this figure 1st round all nodes are alive and along with the round 100 it is zero and then it became re-energetic and be alive on network. The figure 7 is the total energy on WSN. In this figure first the nodes have high energy on network and then it is decreased when the numbers of rounds are increased.

Table 1: Network life time of different protocols

Number of Cluster Area	Network Life Time					
	DEEC		CH-Leach		Proposed work	
	BS 50/50	BS 50/99	BS 50/50	BS 50/99	BS 50/50	BS 50/99
5	1228	1177	1330	1310	1332	1313
10	1227	1198	1412	1397	1413	1399
15	1224	1204	1543	1484	1545	1486
20	1229	1198	1553	1539	1557	1541
25	1249	1261	1695	1641	1697	1643
30	1228	1216	1756	1641	1759	1642

Table 2: Life Time of the Network on Different Cluster area, Base Station located on (50/50).

Number of cluster area	Number of Rounds		
	DEEC	CH-LEACH	Proposed work
5	1177	1300	1410
10	1200	1388	1460
15	1200	1450	1490
20	1200	1500	1550
25	1250	1620	1670
30	1210	1635	1690

Table 3: Life Time of the Network on Different Cluster area, Base Station Located on (edge).

Number of cluster area	Number of Rounds		
	DEEC	CH-LEACH	Proposed work
5	1210	1350	1400
10	1205	1400	1450
15	1200	1570	1600
20	1220	1580	1620
25	1230	1630	1670
30	1210	1780	1820

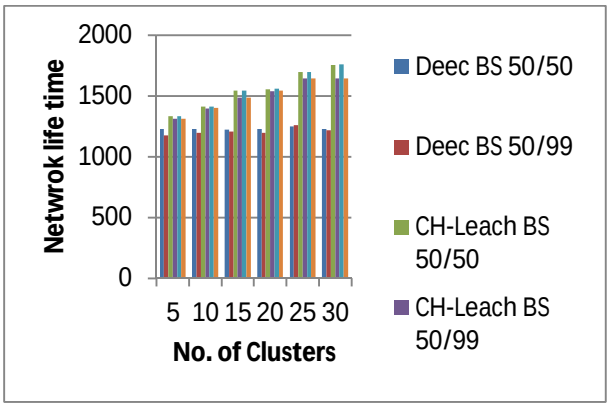

Figure 8: Comparison of different protocols

The figure 8 is the comparison of different protocols along with different position of BS stations on different locations. In this figure Base station location is 50/50 and 50/99 of DEEC, CH-Leach and proposed work protocols.

V. CONCLUSION & FUTURE WORK

Wireless sensor network (WSN) can be considered as an uncommon breed of wireless ad hoc networks with decreased or no mobility. These networks combine wireless communication and negligible on board computation facilities with detecting and monitoring of physical and environmental phenomena. Sensing is a technique used to gather information about a physical object, process, environmental phenomenon or the occurrence of events (e.g. changes in the state such as rise or drop in temperature). These little sizes, low-cost sensor gadgets have inserted on board radio transceiver, micro-controller, memory, power supply and the real sensors. There is dead node identification problem during the transmission of data because at that time path is not identified. Another problem is the network life time problem due to the redundancy. During the transmission energy is lossed, so there is energy consumption problem. There is NP-hard scheduling problem that we have seen in the literature survey. Another problem is the more bandwidth and less network life time problem. When a node becomes more aggressive at the time of transfer and

previously it was not in the cache memory, the other node is bound to receive a packet from it and in such a way it can cause damage to existing routes to implement Hybrid Algorithm for routing in Wireless sensor network using CH-leach and DEEC. Analyze the result being obtained with different parameters like Network lifetime, average energy, dead nodes and number of rounds. In this work novel strategies for both topology and a routing algorithm are proposed to maximization of the network life time. CH-Leach Protocol, an approach of algorithm proposed, this proposed research used number of connection in cluster, and for each cluster head (CH) communicate with base station, however the selection of the cluster head based on the number of cluster on the network gird area, this method allow the network to adopted the best scenario to extend life time of the network, different ways of cluster are formed, in order to avoid the condition that one cluster will contain large of connection nodes and the rest is not, the maximum number of the cluster head is chosen in different scenario to test the network coverage. a series of experiments on different scenarios were implemented and tested. The life time of the network in CH-Leach shows major extension compared to CH-Leach, Deec protocols and proposed protocol. The main aim of this work was to design and implement a protocol which enhance exiting protocols in order extend the Life Time of Network.

Further directions of this study will be deal with clustered sensor networks with more than two levels of hierarchy and more than three types of nodes. For energy consumption in wireless sensor network EEUC protocol, zone-divided and energy-balanced clustering routing protocol (ZECR) is used to enhance this work.

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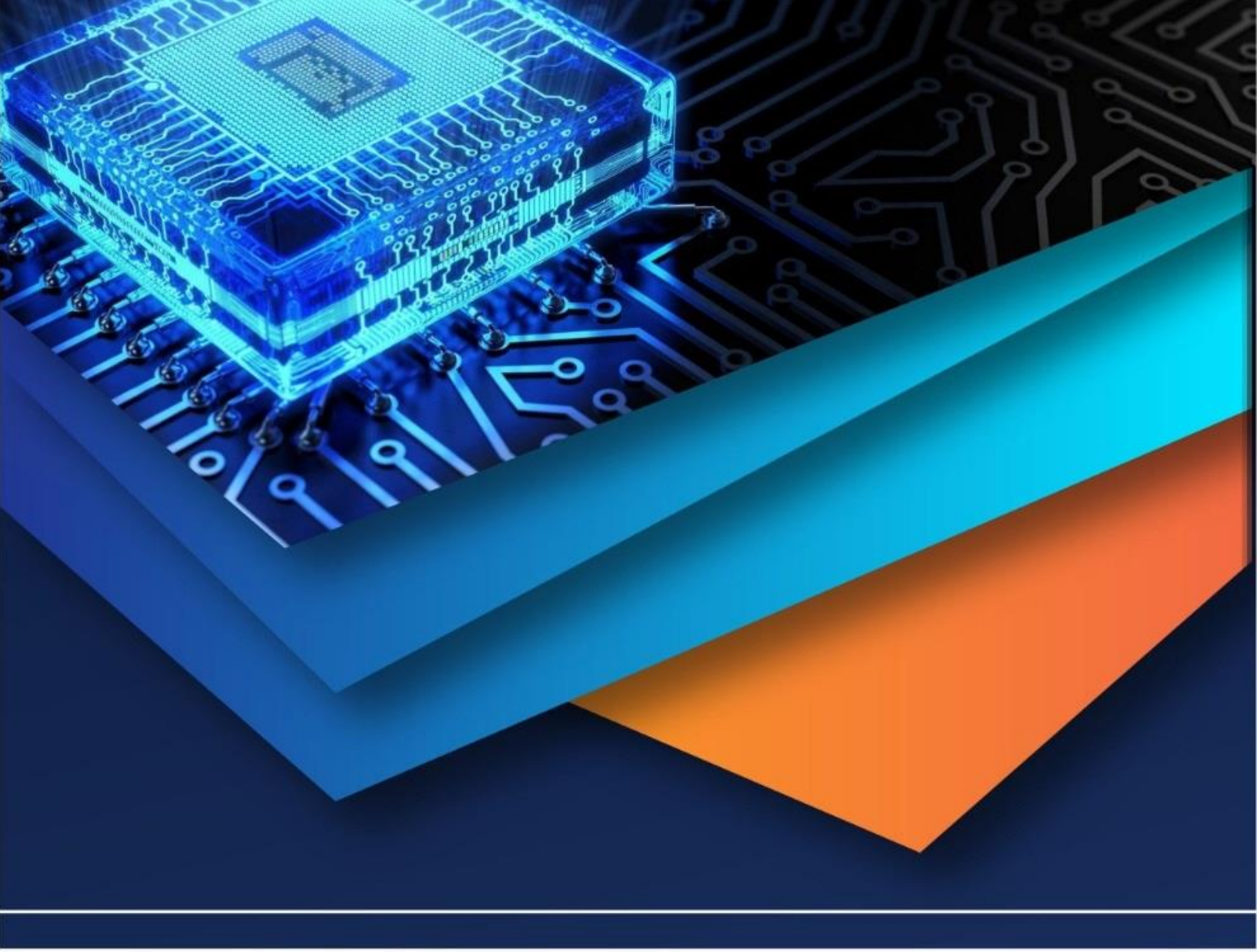

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