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Hybrid Approach Based Routing in Homogeneous Wireless Sensor Networks

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ABSTRACT: Wireless Sensor Network is composed of a large number of small and inexpensive homogeneous sensor nodes connected through wireless network that gather data and send to sink in Multi-Hop or Single-Hop manner. The sensor have limited battery and because of the battery constraints the efficient usage of energy is most desirable criteria for increasing the lifetime of network. Many researchers design efficient routing protocols which reduce the energy consumption. In this paper, a brief introduction to various routing protocols and propose a new cluster based routing technique called HALP (Hybrid Approach of LEACH and PEGASIS) which is combination of both protocol(LEACH and PEGASIS). In this technique clusters are formed on the bases of signal strenght and Cluster Heads sends their data in the form of chain to sink. The proposed scheme is implemented in two ways, in first approach nodes are placed unifromly over the network and in second one nodes are distributed randomly over the network. After simulation results of uniform placement of nodes are found to be better than random deployement. Also the results of proposed technique is compared with previous technique on which it is based and proposed technique obtain much improved results.

KEYWORDS: Single-Hop, Multi-Hop, Clustering LEACH, PEGASIS.

I. INTRODUCTION

Wireless Sensor network collection of low cost and homogenenous sensor nodes that collects the data about the physical enviornment and send to sink (Base Station). It is a wider area of research in which many researchers are given their efforts to propose the techniques which increase the network lifetime because in wireless sensor network the sensors have limited battery capacity. Each sensor node has four components. First is, Communication Device which is used for make a communication between BS (Base Station) and Sensor nodes for data transmission. Second is Controller which is used for data aggregation or computation before transmission. Third component is memory which is used as storage of data. And the last component is Power supply which is basically a energy source which is given to sensor nodes. Energy is main issue in Wireless Sensor Networks and efficient utilization of sensor nodes at the time of transmission is main factor because of limited power supply[1][2].

To transmit the data from Sensor node to BS two routing techniques are used:

1. Single Hop Routing technique: The data that are collect from target area by the sensor nodes are transmit directly to BS as shown in Fig.1. The drawback of this technique is lots of energy consumption at the time of transmission because the position of BS is far away from the network. But on the other hand, there is an advantage of Single hop that is less chance of packet loss.
2. Multi-hop Routing Technique: When the sensor nodes want to transmitted their data then it will firstly send their data to next nearest nodes and that node aggregate the data and then forward to next node or BS. So in this way the energy consumption is less of each node at the time of transmission as compared to Single-Hop.

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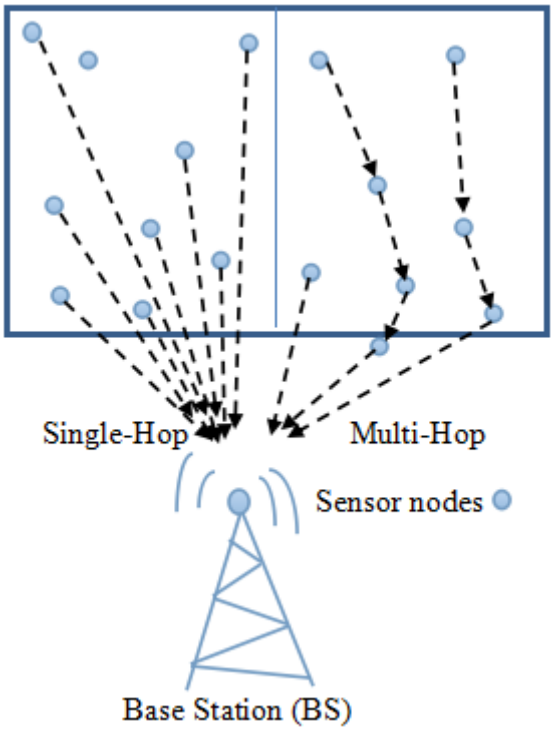

Fig.1. Single-Hop V/s Multi-Hop routing Technique

The Multi-hop Routing is more energy efficient technique as compared to Single-hop routing because the energy consumption is less in Multi-hop technique. But if we see in real world observation of the network, Single-Hop technique is more efficient because the packet loss is less in Single-hop technique as compared to Multi-hop[3].

Clustering of sensor nodes improve the network lifetime in which the clusters are formed and each cluster have one CH (Cluster Head) which is a data aggregation point . Compressing of data from single cluster is called data aggregation in clustering enviornment[4] and that aggregated data send by the CH to BS[5] but in Homogeneous Wireless Sensor Network all nodes have similar battery capacity so the CH have also same energy level like its member node so the CH node will die very quickly as compare to its member nodes[6] because it consume energy for data aggregation and also at time of transmitting an aggregated data to BS. Many researches gives there efforts and proposed various cluster based routing protocol which gives improvements to increase the performance of network.

II. RELATED WORK

In [7] authors proposed first cluster based routing protocol called LEACH (Low Energy Adaptive Clustering Hierarchy) in which Clusters are formed and the CH selects randomly and assign this role to each node in network so that the energy load is equally distributed to all nodes for data transmission and to reduce the amount of information for transmission to Base Station the Cluster Heads aggregates the data that captured by the member nodes and increase the performance and lifetime of network. In [8] authors proposed **LEACH-C** (Low Energy Adaptive Clustering Hierarchy-Centralized) protocol who was a Centralized clustering algorithm in which the CH selection and formation of cluster is depend upon the BS because in this protocol all sensor nodes send their information about their energy level and position to BS and BS decide who become a CH. The disadvantage of this protocol is that it is totally depend upon Base Station. In [9] author proposed improved version of LEACH protocol called **PEGASIS** (Power Efficient GAthering in Sensor Information System) protocol. In PEGASIS the data gathering is done in the form of chain i.e. each sensor nodes send their data to nearest neighboring node this node send to next nearest node so like this chain is formed of sensor nodes and at last send the data to BS. In [10] authors proposed an algorithm called **ANCAEE** (A Novel Clustering Algorithm for Energy Efficiency in Wireless Sensor Networks) in which the member nodes in cluster transmit their data in Single-Hop manner to CH and CH send their data in Multi-Hop manner to BS. In [11] authors proposed the improved version of PEGASIS called **Hop-PEGASIS**. This algorithm is similar to Hierarchical

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PEGASIS[12] in which each transmit their data to next node present in upper level of hierarchy until reaches to the BS. But in Hop-PEGASIS firstly cluster are formed and each cluster have one CH. There is 5 level assumed in this algorithm of CH, those CHs which are near to BS is at level 1 and those far away from the BS is at level 5. So the data transmission is done like in Hierarchical PEGASIS between the CH.

III. PROPOSED ALGORITHM

The main idea in propose work is depend upon the transmission technique of aggregated data from sensor node to BS. There are some properties of this sensor network:

- BS is far away from the monitoring area.
- The network is homogeneous i.e. all nodes have equal energy level, hardware complexity, etc.
- The sensor nodes and BS is immobile means once the nodes are deployed they all are fixed and BS position is also fixed. No mobility factor is present in sensor nodes and BS.
- BS don't know the position of sensor nodes.
- CH is data aggregation point, which aggregates the data that capture from the member nodes .

Propose technique is a hybrid approach based routing technique in which two technique are combined i.e. LEACH and PEGASIS called HALP(Hybrid Approach of LEACH and PEGASIS). It is a cluster based routing technique. The formation of cluster is based on signal strenght and randomly selection of CH as like in LEACH protocol. Data transmission from member node to CH is done in Single-hop manner. Each member node sends their data directly to its CH and CH which is a data aggregation point, it collect the data from its member node aggregate it. Now the Cluster Heads send their aggregated data to BS in the form of chain. The starting CH of chain is selects randomly and that CH send their data to the next nearest CH until data reaches to BS asshown in Fig. 2. Again CH reschedules and new chain will formed again.

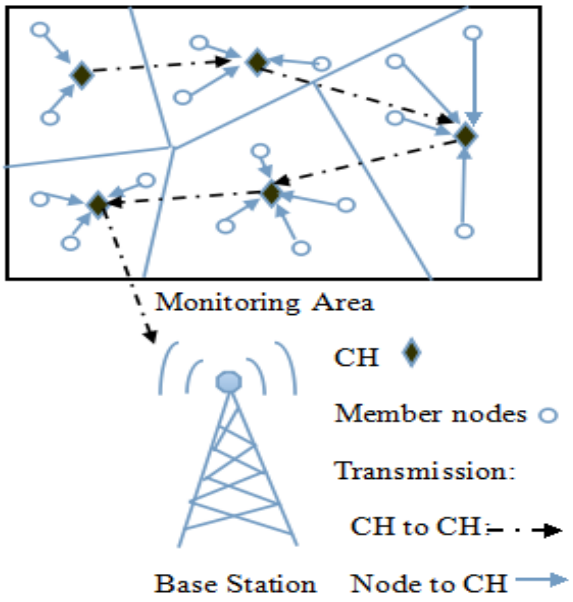

Fig.2. Architecture of Proposed Work

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System Model[13]
In propose work, using basic radio Signal propagation model .

Table1. Radio Model Characteristics

Parameters Name	Values of Energy Dissipation
Transmitter electronics($E_{Tx}(l,d)$) Receiver Electronics($E_{Rx}(l)$)	50nJ/bit
Transmit Amplifier(ε_{amp})	0.0013nJ/bit
Transmit Amplifier(ε_{fs})	10 pJ/bit/ m^2

If transmitting the l-bit message with distance d then according to this model the radio expends:

$$E_{Tx}(l,d)=\begin{cases}E_{elec}*l+\varepsilon_{fs}*l*d^2 & d\le d_o\\ E_{elec}*l+\varepsilon_{mp}*l*d^4 & d>d_o\end{cases}$$

Where E_{elec} energy consumption per bit for transmitting and receiving circuitry and d_o is a distance threshold value set for between the free space and multi path fading model and its value is calculated by using transmitter amplification energy dissipation i.e. $d_o=\sqrt{\frac{\varepsilon_{fs}}{\varepsilon_{mp}}}$.

Fig.3 shows a flow chart of proposed work i.e. how a technique will work. The below figure shows methodology which used to implement the new technique which is shown in above figure.

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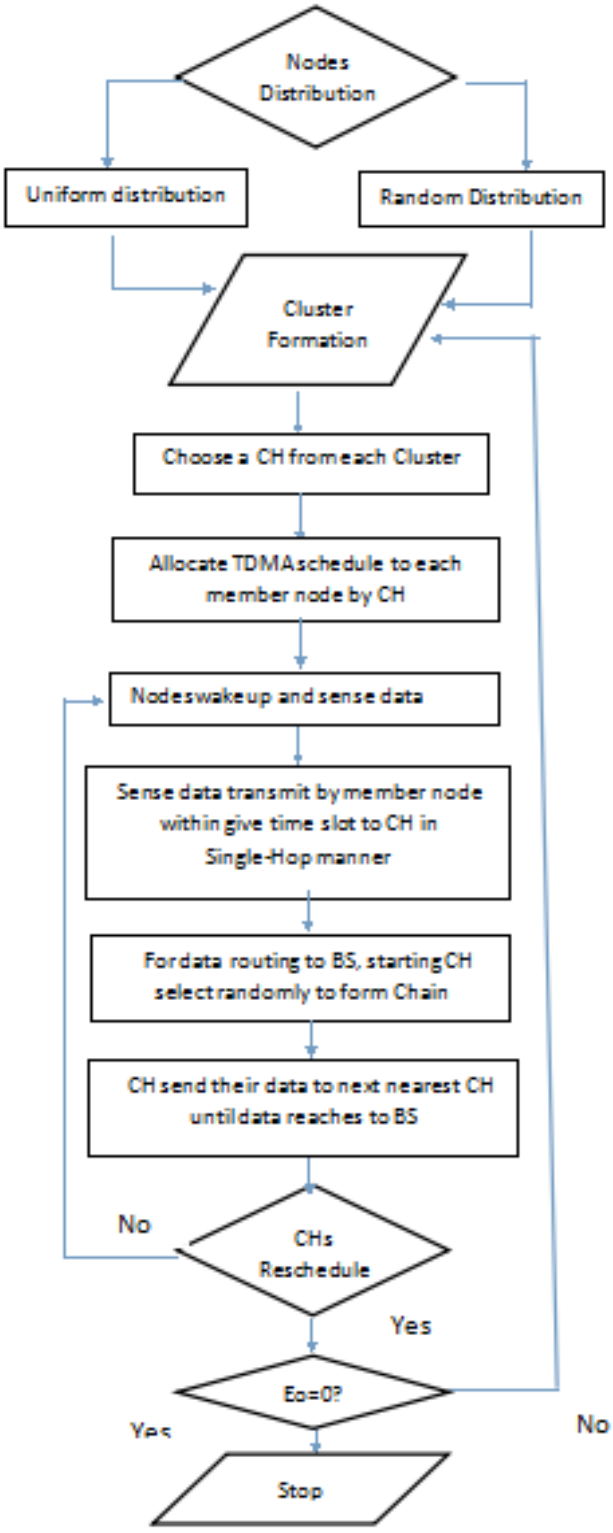

Fig. 3 Flow Chart of proposed work

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IV. PSEUDO CODE

Pseudo Code

nЄN
r←random(0,1)
If r<T(n)==True
  CH ←n
endif
If CH(n)==True
  CH(n) send Adv_pckt to all n_i ЄN
  for every CH in K_{CH}
  On the bases of Signal strength to receive ADV_pckt
  for each $K_{nCH}(n_i)$ determine CH
n_i Є K_{nCH} send JOIN(node_ID,CH_ID,header) packet to CH(n_i)Є K_{CH}
endif
In Cluster(c) CH send TDMA slot to all K_{nCH}
K_{nCH} send the data to K $_{CH}$ and K $_{CH}$
AGGREGATE the data
Randomly select starting CH(n_i) for chain formation of CHs to route the data to BS
Data of CH(n_i) $\xrightarrow{\text{transmit}}$ st CH(n_{i+1})
route the data to BS

V. SIMULATION RESULTS

In the homogeneous network there is 100 sensor nodes are deployed in 100m x 100m and position of BS is 50m x 300m. We check the result of HALP technique on three different initial energy which are given to sensor nodes i.e. 0.25J, 0.5J and 1.0J. The packet size is 2000 and we evaluate the lifetime of sensor nodes on the bases of round number means we evaluate FND(First Node Dead), HND(half Node Dead) and LND(Last Node Dead). In this paper we show two comparisons first Uniform v/s Random Homogeneous network and another comparison of results with previous techniques.

A. Uniform v/s Random Homogeneous WSNs.

Deploy 100 sensors nodes in the 100mx100m field.

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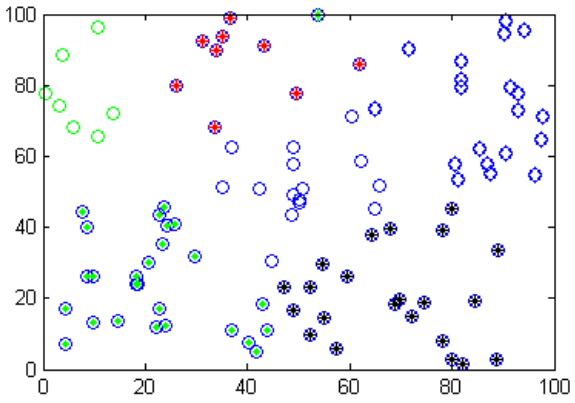

Fig.4 Random deployment of sensor nodes

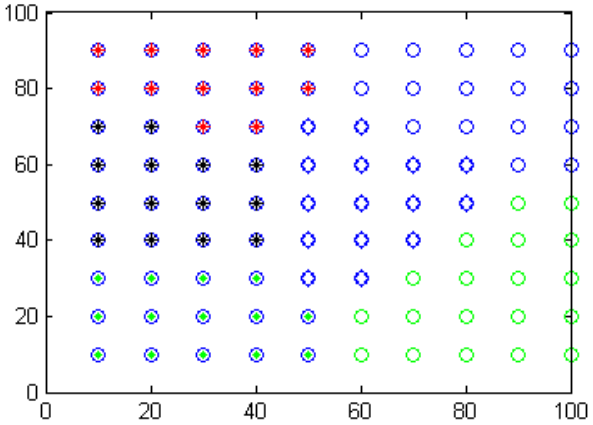

Fig.5. Uniform Deployment of sensor nodes

In Fig.4 randomly deploy the nodes in the field and these sensor are grouped to form a cluster and the clusters are represent with different colors. Same as in Uniform deployment of nodes show in Fig.5. In this section we compare the results of both deployment strategy on the bases of round numbers and shows that, in which network the nodes are survive for more time.

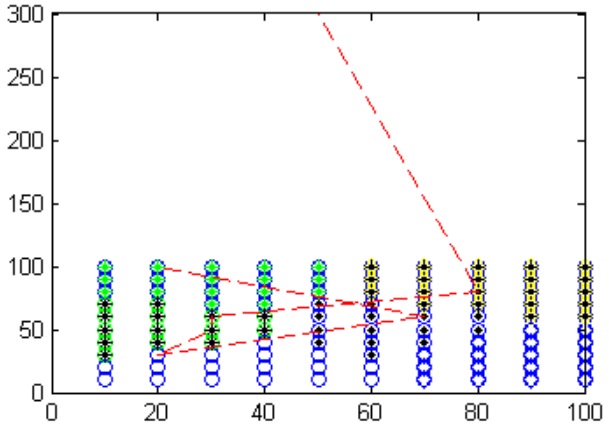

Fig.6 Chain formation of CHs route the data to BS in Uniform Homogeneous WSNs.

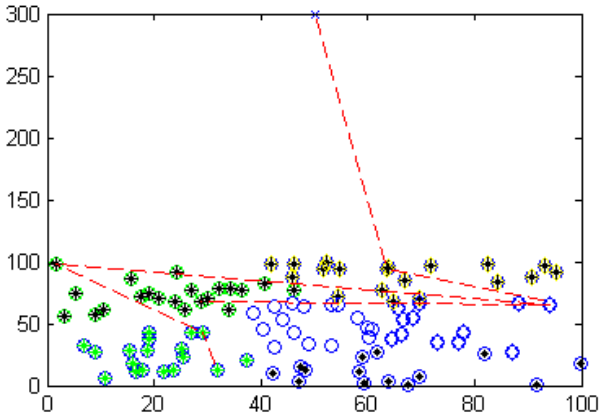

Fig.7. Chain Formation of CHs in Random homogeneous WNSs.

As show in Fig.6 in which the red line represents the transmission of Aggregated data to BS in the form of chain. First CH which is starting point of chain is select randomly and CH send their aggregated to next nearest CH atlast the aggregated data send to BS in the form of chain show in Fig.6 and Fig.7 also.

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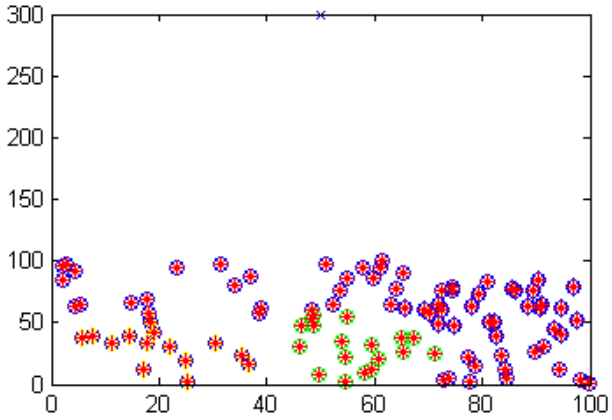

Fig.8 All nodes are dead

Fig.8 shows that the all nodes are dead it means the initial energy is equal to zero (Eo = 0).

Table 2. Rounds number when FND, HNDand LND die.

Energy	Network Type	FND	HND	LND
0.2	Random	359	428	500
	Uniform	382	434	584
0.5	Random	760	851	949
	Uniform	766	930	1032
1.0	Random	1629	1872	2000
	Uniform	1641	1871	2031

Table 2 summarized the performance of the both Random Homogeneous Wireless Sensor Network and Uniform Homogeneous Wireless Sensor Network. As we see in the table the number of rounds represent the in which network the sensor nodes survival for more time. We compare the performance on three different level of energy and analyze that the Uniform Homogeneous Wireless Sensor Networks gives better performance as compare to Random deployment. The survival time of sensor nodes in the uniform is more as compare to random. When energy is 0.25 the FND on round number 359 in random network but in Uniform network the FND on 382 round number. So the survival time is more of sensor node in the Uniform Homogeneous WSNs.

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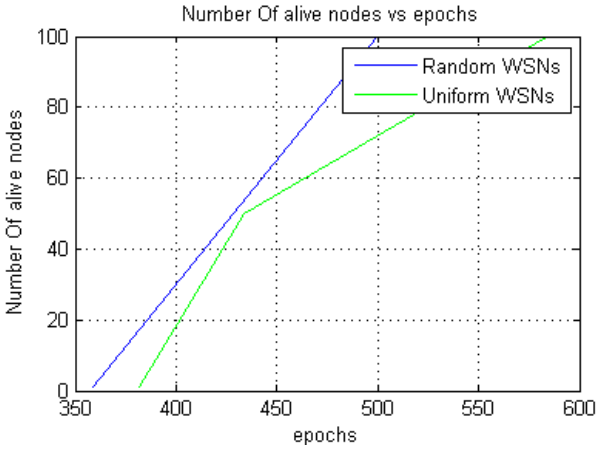

Fig.9. Perform result for 100mx100m network with energy E_o =0.25J

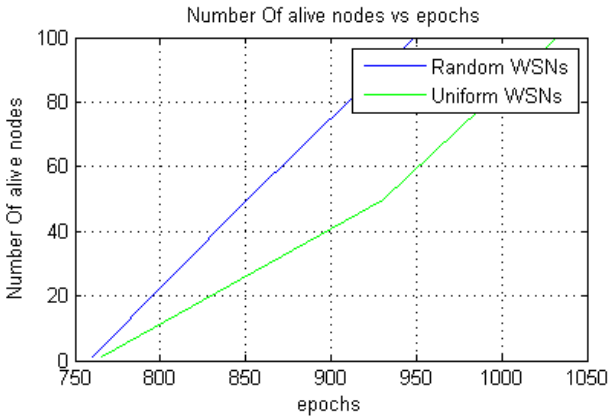

Fig.10. Perform result for 100mx100m network with energy E_o =0.5J

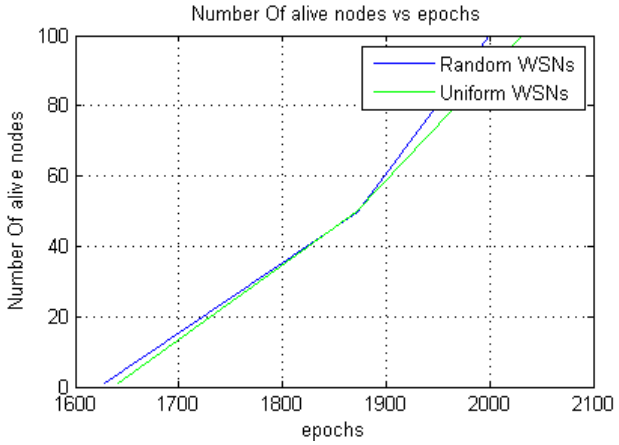

Fig.11. Perform result for 100mx100m network with energy E_o =1.0J

In Fig.9, Fig.10 and Fig.11 is graphical representation of comparison the results of both network random and uniform. In these figures we plot the graph number of dead nodes v/s round number by using the results shown in Table 2.

B. Comparison of proposed Technique with Existing Technique.

In this section we take a random Homogeneous WSNs and compare the results with existing techniques Direct Transmission, LEACH and PEGASIS by referring the results given in PEGASIS[9] research paper.

In this paper we propose the HALP technique and compare it with existing technique show in Table 2. This table summarize that the proposed technique give better performance to increase the lifetime of network

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Table 2. Rounds number when FND, HND and LND die

Energy	Protocol	FND	HND	LND
0.25	Direct	14	20	30
	LEACH	166	232	308
	PEGASIS	335	684	779
	HALP	359	428	500
0.5	Direct	28	40	61
	LEACH	339	461	576
	PEGASIS	675	1362	1544
	HALP	760	851	949
1.0	Direct	56	80	122
	LEACH	690	911	1077
	PEGASIS	1346	2720	3076
	HALP	1629	1872	2000

because if see the round number when fist node dead like when E_o =0.5, the first node will on 760 round number in proposed technique which implies that the survival time of sensor nodes in the proposed technique is more as compared to existing technique. These results are represent in the graphical form show in Fig.11, Fig.12 and Fig.13.

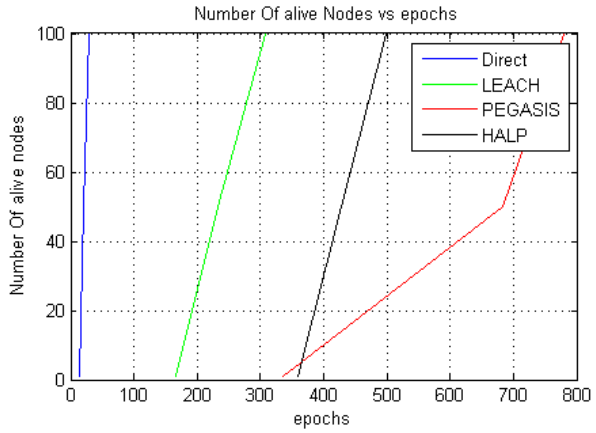

Fig.11 Performance results of comparison of proposed technique with existing technique when E_o =0.25J

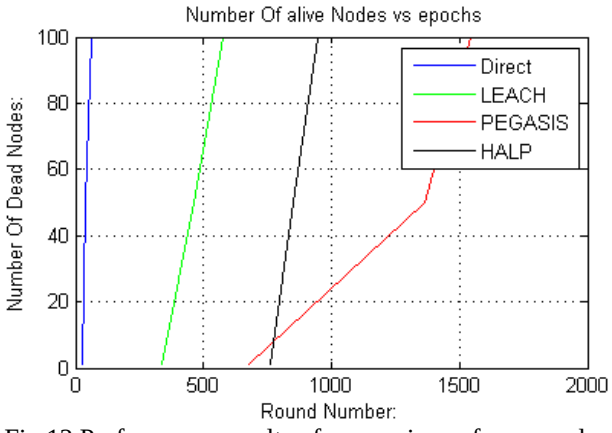

Fig.12 Performance results of comparison of proposed technique with existing technique when E_o =0.5J

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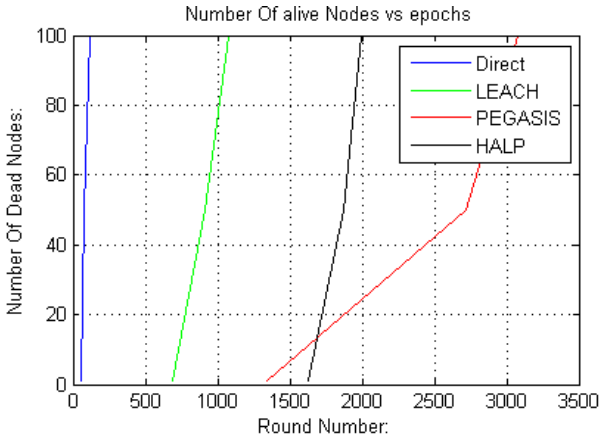

Fig.13 Performance results of comparison of proposed technique with existing technique when E_o =0.1J

In these three figures represent the performance results in the form of graph which is easy to understand and shows that which technique gives better performance to increase the lifetime of network. We plot the four different lines with different color in the graph each line We predict the performance of previous and proposed technique by plotting the round number when 1%, 50% and 100% nodes are dead.

VI. CONCLUSION AND FUTURE WORK

All the previous techniques are energy efficient whose aim to increase the lifetime of sensor nodes. Main factor in WSNs is to energy dissipation at the time of transmission because the most of energy consumption is at the time of transmission or routing of data to BS. In this paper we propose the hybrid based routing technique HALP(Hybrid Approach of LEACH and PEGASIS) in which CH selection procedure is done as like of LEACH protocol and CHs route their aggregated data to BS in the form of chain. The data will send to BS in the form chain of CH. This technique is applied on two type of network deployment strategy uniform Homogeneous WSNs and Random Homogeneous WSNs. Simulation results shows that the Uniform Homogeneous Networks gives better results to increase the survival time of sensor nodes. And in the next section of Result we compare the proposed technique with existing technique LEACH, Direct and PEGASIS. The proposed technique gives little better results from the previous techniques because the first node dead in previous technique early as compare to proposed technique so that it will shows that the proposed technique extend the lifetime of sensor nodes in network.

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BIOGRAPHY

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