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Improving the Network Lifetime of WSN Using Dynamic Stable Leach Election Protocol

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***Abstract*— This paper proposes a new dynamic strategy for selecting the optimal cluster head in Stable Election Protocol (SEP). The proposed strategy selects a node as cluster head if it has the maximum energy among all the available nodes in that particular cluster. The maximum energy is that which is calculated at running time of the WSN. The proposed strategy considers heterogeneous nodes and divides nodes among normal, intermediate and advance nodes. To handle the heterogeneity of the nodes, different optimized probability density functions are selected. The proposed strategy is designed and implemented in the MATLAB tool using mathematics toolbox. The proposed algorithm is also compared with the some well known protocols like LEACH, E-LEACH, SEP and Extended SEP.**

***Index Terms*— LEACH, SEP, WSN, Energy, Network lifetime, Throughput**.

I. INTRODUCTION

Wireless communication technologies continue to grow in diverse areas to provide new opportunities for networking and services. One fast-moving area is wireless sensor networks (WSN). With the advances in micro-electro mechanical systems, sensor devices can be built as very small lightweight wireless nodes. WSN are highly distributed networks of such kind of sensor nodes, and have been deployed in large numbers to monitor the environment or production systems. There is a growing need for the nodes to handle more complex functions in data acquisition and processing, and energy saving solutions remains a major requirement for these battery-powered sensor nodes. Three major functions are performed by sensor; the data processor that performs local computations on the data sensed; and the communicator that performs information exchange between neighboring nodes. Each sensor is usually limited in their energy, processing power and sensing ability. However, networks of these sensors give rise to a robust, reliable and accurate network. The sensors can collaborate and cooperate among each other, elect leaders or heads, gather their data and then transmits a more results from the sensing. Lots of studies on WSN have been carried out in laboratories. WSN systems are increasingly demanding with new applications in various areas wireless sensor networks are consisted of thousands of small sensors that span a large geographical region. These sensors are able to communicate with each other to collaboratively detect objects, collect information and transmit messages. However, as sensors are usually small in size, they have many physical limitations such as battery, computational power and memory. Because of those limitations, energy-efficient techniques are main research challenges in wireless sensor networks.

A number of techniques have been proposed to solve these challenges. LEACH (Low-Energy Adaptive Clustering Hierarchy) is one of the famous techniques in wireless sensor networks. This is a cluster-based protocol that utilizes randomized rotation of local cluster base stations (cluster-heads) to evenly distribute the energy load among the sensors in the network. This technique can reduce a number of transmissions in clusters. However, the intense data flow can be harmful, especially in wireless sensor networks, since congestions and collisions may be occurred. Traditional server/client-based techniques like a LEACH cannot utilize autonomous-repair and scalability and so on. And also it gives too much burden on base-station. Wireless Sensor Networks (WSNs) are networks of light-weight sensors that are battery powered used majorly for monitoring purposes. The advances in micro-electromechanical technologies have made the improving of such sensors a possibility. Recently, WSNs have been heavily researched by several organizations and by the military where we can enhance some of the applications in battle surveillance and other security devices. However, while WSNs are increasingly equipped to handle some of these complex functions, in-network processing such as data aggregation, information fusion, computation and transmission activities requires these sensors to use their energy efficiently in order to extend their network life time. Sensor nodes are prone to energy drainage and failure, and their battery source might be irreplaceable, instead new sensors are deployed. This can negatively impact the stability and performance of the network system if the extra energy is not properly utilized. LEACH protocol and the likes assume a near to perfect system; an energy homogeneous system where a node is not likely to fail due to uneven terrain, failure in connectivity and packet dropping.

But more recent protocols like SEP is considered the reverse that is energy heterogeneity where the factors mentioned above are a possibility, which is more applicable to real life scenario for WSN. Thus, energy heterogeneity should therefore be one of the key factors to be considered when designing a protocol that is robust for WSN. The goal is to present a modified protocol design that is more robust and can ensure longer network life-time while taking other performance measures into consideration. Sensor network should be adaptive and sensitive to the dynamic environment

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where they are deployed. Since nodes are battery-powered and communications are radio-based, nodes are more susceptible to failures. The information collected by individual node should be aggregated to give more accurate and reliable results. Sensor network should be reliable and be able to provide relevant data through information gathering techniques. The hardware design should incorporate methods to conserve energy using low powered processors and the system software should use minimal power as possible. A sensor network algorithm should be distributed and self-organizing, since WSN is infrastructure-less. The security of the network should also be considered. Scalability is another important factor to be considered when designing a topology for WSN.

II. LITERATURE SURVEY

Guisheng Yin et al. [2008] [1] Since the nodes of wireless sensor networks are in the condition of a highly-limited and un replenish able energy resource such as battery power, computation, and storage space, the energy efficiency is the most important key point of the network routing designing.

Haosong Gou et al. [2010] [2] Wireless sensor networks (WSNs) have been considered as a promising method for reliably monitoring both civil and military environments under hazardous or dangerous conditions. Due to such environments, the power supplies for sensors in the network are not usually rechargeable or replaceable. Therefore, the energy efficiency is critical for the lifetime and cost of WSN. Numerous mechanisms have been proposed to reduce the impact of communication protocols on the overall energy dissipation of WSN. The low-energy adaptive clustering hierarchy (LEACH) and another improved centralized LEACH deploys randomized rotation of cluster-heads to evenly distribute the energy load among all sensors in a WSN.

Heikki Karvonen et al. [2004] [3] has studied the effect of coding on the energy consumption in wireless embedded networks. An analytical model of the radio energy consumption is developed to study how different DC balanced codes affect the energy consumption for the one-hop case. A Rayleigh fading channel is assumed, the analysis is extended to include multihop scenarios in order to study the tradeoff between coding overhead and energy consumption.

Hongjoong Sinet al. [2008] [4] adopted biologically inspired approaches for wireless sensor networks. Agent operates automatically with their behavior policies as a gene. Agent aggregates other agents to reduce communication and gives high priority to nodes that have enough energy to communicate. Agent behavior policies are optimized by genetic operation at the base station. Simulation results show that our proposed framework increases the lifetime of each node. Each agent selects a next-hop node with neighbor information and behavior policies.

Huu Nghia Le et al. [2012] [5] has proposed a distributed, energy efficient algorithm for collecting data from all sensor nodes with minimum latency called Delay-minimized Energy-efficient Data Aggregation algorithm (DEDA). The DEDA algorithm minimizes data aggregation latency by building a delay-efficient network structure. At the same time, it also considers the distances between network nodes for saving sensor transmission power and network energy. Energy consumption is also well balanced between sensors to achieve an acceptable network lifetime.

Linlin Wang et al. [2010] [6] Wireless sensor network is composed of hundreds of sensor nodes involving in limited energy, efficient and low-energy consuming routing algorithm is the crucial problem to the routing design.

Ma Chaw Mon Thein et al. [2010] [7] Recent advances in wireless sensor networks have led to many new protocols specifically designed for sensor networks where energy awareness is an essential consideration. Clustering is a key routing technique used to reduce energy consumption. Clustering sensors into groups, so that sensors communicate information only to cluster heads and then the cluster-heads communicate the aggregated information to the base station, saves energy and thus prolonging network lifetime.

Meenakshi Sharma et al. [2012] [8] Routing protocols like EEE LEACH, LEACH and Direct Transmission protocol (DTx) in Wireless Sensor Network (WSN) and a comparison study of these protocols based on some performance matrices. Addition to this an attempt is done to calculate their transmission time and throughput. To calculate these, MATLAB environment is used. Finally, on the basis of the obtained results from the simulation, the above mentioned three protocols are compared.

M M Islam et al. [2012] [9] has presented algorithm considers the sensor nodes are static and randomly distributed in the heterogeneous network, the coordinates of the sink and the dimensions of the sensor field are known.

Reetika Munjal et al. [2012] [10] has studied that the main problem with the LEACH lies in the random selection of cluster heads. There exists a probability that cluster heads formed are unbalanced and may remain in one part of network making some part of network unreachable. Here our main purpose is to select a cluster head depending upon its current energy level and distance from the sink node. This increases the energy efficiency and hence network lifetime.

Rupesh Mehta et al. [2012] [11] has discussed that the LEACH (Low Energy Adaptive Clustering Hierarchy) protocol randomly selects a few nodes as cluster heads based on a probability model. The probabilistic approach leads to the formation of unequally sized clusters which leads to imbalance in energy consumption across the network and thereby reduces the efficiency and network lifetime.

Shuo Shi et al. [2012] [12] has discussed that the largest energy consumption for a single cluster head in the next round will be estimated, and all nodes with residual energy larger than the calculated consumption will be taken to a new round of simulated annealing to find a better solution. Thus, loss of the cluster head for each round can be minimized, and the WSN lifetime can be extended ultimately.

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Smaragdakis et al. [2004] [13] has proposed SEP (Stable Election Protocol) so every sensor node in a heterogeneous two-level hierarchical network independently elects itself as a cluster head based on its initial energy relative to that of other nodes.

Thu Ngo Quynh et al. [2012] [14] Wireless Sensor Network (WSN) is a promising approach for a variety of applications. Because of limitation of energy resource, memory space and processing capability of sensor nodes, it is very difficult to implement IP-based routing protocols in WSN. Recently, many research focus on developing special routing protocols for WSNs with the main design criteria: energy efficiency, load balance and reliability.

Vivek Katiyar et al. [2011] [15] As the use of wireless sensor networks (WSNs) has grown enormously in the past few decades, the need of scalable &energy efficient routing and data aggregation protocol for large scale deployments has also risen. LEACH is a hierarchical clustering protocol that provides an elegant solution for such protocols.

Yuhua Liu et al. [2009] [16] has discussed that the non cluster-heads choose optimal cluster-head, they consider comprehensive nodes' residual energy and distance to base-station, then compare their performance, the simulation results show that the new strategy of cluster-heads election achieve great advance in sensor and networks' life-time.

Zach Shelby et al. [2005] [17] has provided an analytical model for the study of energy consumption in multihop wireless embedded and sensor networks where nodes are extremely power constrained. Low power optimization techniques developed for conventional ad hoc networks are not sufficient as they do not properly address particular features of embedded and sensor networks. It is not enough to reduce overall energy consumption, it is also important to maximize the lifetime of the entire network, that is, maintain full network connectivity for as long as possible.

Zhi-feng Duan et al. [2009] [18] A Mobile Wireless Sensor Network consisting of a large amount of tiny sensors with low-power can be an effective tool for gathering data in a variety of environments. The data collected by each sensor is transmitted to a single processing center that uses all data to determine characteristics of the environment. Sensors deployed in all kinds of areas on a large scale can move with wind and water.

III. EXPERIMETAL SET UP

In this work, the authors assumed a three-level hierarchical clustered heterogeneous sensor network with 100 sensor nodes which are randomly distributed over the 100×100 m2 area. The sink or base station is located at point (90×90). The packet size that the nodes send to their cluster heads as well as the aggregated packet size that a cluster head sends to the sink is set to 4000 bits. The initial energy of each normal node is set to 0.5 Joule. The proposed approach has been implemented in MATLAB and the performance has been evaluated by simulation. In this work, we have measured the lifetime of the network in terms of rounds when the first sensor node dies. All the parameter values including the first order radio model characteristic parameters are mentioned in the Table 1 below:

PARAMETERS	VALUES
Sensor field	100×100
Sink position	90×90
N	100
Packet size	4000
Efs	10pJ/bit/m^2
Emp	0.0013pJ/bit/m^4
E_{DA}	50nJ/bit
E_O	0.5 J
P	0.1
a	2
b	1
m	0.3
x	0.3

Table 1: Various parameters and their values

IV. HETEROGENEOUS WSN MODEL

In this section, the authors describe the heterogeneous wireless sensor network model which includes cluster formation and maintaining optimum number of clusters.

A. Creation of a cluster

In our work, we have considered a three tier hierarchical clustered network. The Low Energy Adaptive Clustering Hierarchy (LEACH) is a protocol which is hierarchically clustered where clusters are re-established in each round. In this protocol, new cluster heads get elected in each round and as a result the load becomes well distributed and balanced among the nodes of the network. An optimal percentage of nodes p_{opt} is considered that has to become cluster head in each round. We have assumed the same distributed algorithms to form clusters in the network. To decide whether a node to become cluster head or not a threshold T(s) is addressed in which is as follows:

$$T(s)=\begin{cases}\dfrac{p_{opt}}{1-p_{opt}.(r.\mathrm{mod}.\frac{1}{p_{opt}})}, ifs\in G' \\ 0, otherwise\end{cases} \quad (1)$$

Where r is the current round number and G is the set of nodes that have not become cluster head within the last $1/p_{opt}$ rounds. At the beginning of each round, each node which belongs to the set G selects a random number 0 or 1. If the random number is less than the threshold T(s) then the node becomes a cluster head in the current round.

B. Optimum number of clusters

According to the radio energy model addressed in [2], in order to achieve an acceptable SNR in transmitting an L bit message over a distance d, the energy dissipated by the radio is given by:

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$$E_{Tx}(l,d)=\begin{cases} L.E_{Elec}+L.\epsilon_{fs}.d^2, if d\le d_0 \\ L.E_{Elec}+L.\epsilon_{mp}.d^4, if d\ge d_0 \end{cases} \quad (2)$$

Where E_{Elec} is the energy dissipated per bit to run the transmitter or receiver circuit, ϵ_{fs} (free space fading) and ϵ_{mp} (multi path fading) are the energy expenditure of transmitting one bit data to achieve an acceptable bit error rate and d is the distance between a cluster member node and its cluster head. By equating the two expressions at $d = d_0$, we get

$$d_0=\sqrt{\frac{\epsilon_{fs}}{\epsilon_{mp}}} \quad (3)$$

So according to [2], the optimum number of clusters kopt for our cluster based network, having n sensor nodes distributed randomly in a (MxM) sensor field is as follows:

$$k_{opt}=\sqrt{\frac{n}{2\pi}}.\sqrt{\frac{\epsilon_{fs}}{\epsilon_{mp}}}.\frac{M}{d^2} \quad (4)$$

Again, the optimal probability of a sensor node to become cluster head can be calculated as:

$$p_{opt}=\frac{k_{opt}}{n} \quad (5)$$

V. PROPOSED PROTOCOL

In this work, we have analyzed a three-tier node scenario in a heterogeneous sensor network environment. There are p is the percentage of advance, intermediate and normal nodes having a times more energy than the normal nodes that are distributed randomly over the sensor field. A cluster head election process is considered based on the battery power and residual energy of the node. In our approach, intermediate and advanced nodes have higher probabilities to become a cluster head in a particular round than the normal nodes. The proposed heterogeneous network model doesn't effect on the spatial density of the network but changes the total initial energy of the network. We have individual initial energy equations for intermediate and advanced nodes as follows:

$$E_1=E_0.(1+a) \quad (6)$$

$$E_2=E_0.(1+b) \quad (7)$$

Where, E_0=Energy of a normal node
E_1=Energy of a intermediate node
E_2=Energy of an advanced node
The total initial energy of three types of nodes is as follows:

$$E_{t0}=n.E_0.(1-p-k) \quad (8)$$

$$E_{t1}=n.p.E_0.(1+a) \quad (9)$$

$$E_{t2}=n.k.E_0.(1+b) \quad (10)$$

Where, E_{t0}=Total initial energy of normal nodes
E_{t1}=Total initial energy of intermediate nodes
E_{t2}=Total initial energy of advanced nodes
The total initial energy of the new heterogeneous sensor network model is given by equation(11):

$$E_t=n.E_0.(1-p-k)+n.p.E_0.(1+a)+n.k.E_0.(1+b)$$
$$E_t=n.E_0.(1+p.a+k.b) \quad (11)$$

In this work, we have approached to assign a weight to the optimal probability of a sensor node (p_{opt}) to become cluster head in a particular round. This weight must be equal to the division of the initial energy of each node by the initial energy of a normal node. If all the nodes are homogeneous, all the nodes will become cluster head once every $1/p_{opt}$ round which is coined as epoch of the network. In order to maintain the minimum energy consumption in each round within an epoch, the average number of cluster heads per round per epoch must be constant and equal to p_{opt} .n. In our approach the average number of cluster heads per round per epoch is equal to n.(1+p.a+k.b). In [2], the weighted election probabilities for normal and advanced nodes are defined. In our three tier node scenario, the weighted election probabilities for the normal, moderate and advanced nodes are as follows:

$$P_{nrm}=\frac{p_{opt}}{1+p.a+p.b} \quad (12)$$

$$P_{adv}=\frac{p_{opt}}{1+p.a+p.b}.(1+a) \quad (13)$$

We further define the thresholds T(snrm), T(sadv) for the normal, advanced nodes. In equation (1) we have replaced popt by the weighted probabilities of normal and advanced nodes to get the threshold that is used to elect the cluster head in each round. Thus, the threshold for the normal nodes to become cluster head can be evaluated by the following equation:

$$T(s_{nrm})=\begin{cases} \dfrac{p_{nrm}}{1-p_{nrm}.(r.\mathrm{mod}.\frac{1}{p_{nrm}})}, if s\in G' \\ 0, otherwise \end{cases} \quad (14)$$

Where r is the current round number, G' is the set of normal nodes that have not become cluster head within the last 1/pnrm rounds of the epoch. T(snrm) is the threshold applied to a population of n.(1-p-k) that are normal nodes. This ensures that each normal node will become a cluster head exactly once every (1+p.a+k.b)/pnrm rounds per epoch and that the average number of cluster heads that are normal nodes per round per epoch is equal to n.(1-p-k). Similarly, thresholds T(sint) and T(sadv) for intermediate and advanced nodes are also evaluated.

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VI. PERFORMANCE ANALYSIS

A. WSN in active stage

Figure 1 is showing the WSN in active mode where all nodes are active. Nodes represent by circles are normal nodes and nodes with circle and star (*) are cluster heads. Nodes represent by triangle are intermediate nodes and nodes with triangle and star (*) are cluster heads. Nodes represent by diamond are advance nodes and nodes with diamond and star (*) are cluster heads. The entire network has a base station that is responsible for the collection of data from all other nodes.

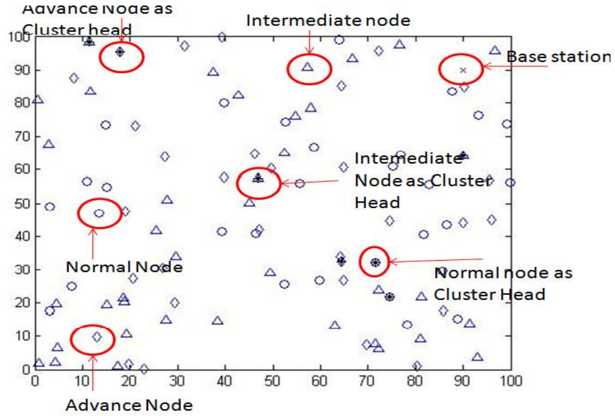

Fig 1 Initial configuration of WSN

B. First Dead node

Figure 2 is demonstrating the LEACH with active as well as with some dead nodes represent by red diamond. Figure 2 shows the dimension area of 100*100, there are 100 nodes in total in which some are active represent by circles (o), some are cluster head represent by using circle and star (*) , triangle and star (*) , diamond and star (*) and also red diamonds represent the node dead so far during the life cycle of wireless sensor network.

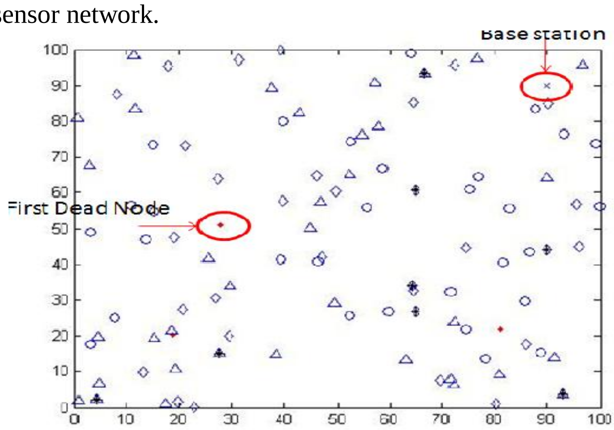

Fig 2 First Dead Node

C. ALL Dead nodes

Figure 3 is representing all dead nodes represent by red diamond. Figure 3 also shows the dimension area of 100*100, there are 100 nodes and red diamonds represent the node dead so far during the life cycle of wireless sensor network. The entire network has a base station that is responsible for the collection of data from all other nodes.

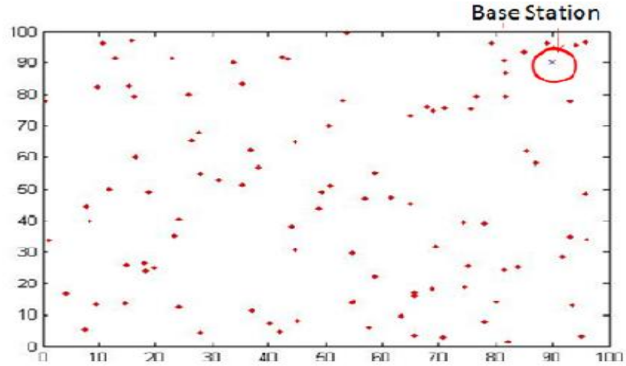

Fig 3 All Dead nodes

Performance Evaluation:

	LEACH	E-LEACH	SEP	ESEP	PROPOSED
First Dead Node	920	1560	969	1854	2343
Last Dead Node	1420	2800	3350	3414	3750

D. Throughput

Figure 4 is showing the Packets that are sent to Base Station in Leach Protocol during the lifetime of the Leach protocol. It shows the throughput from 0 rounds to 1420 as 1420 is the overall lifetime of leach in our experiment. Here y axis shows the amount of packets sent during running time. It is clearly shown that the packets goes down rapidly recently after the first node dead, which clearly shows the benefits of the stability period of wireless sensor network.

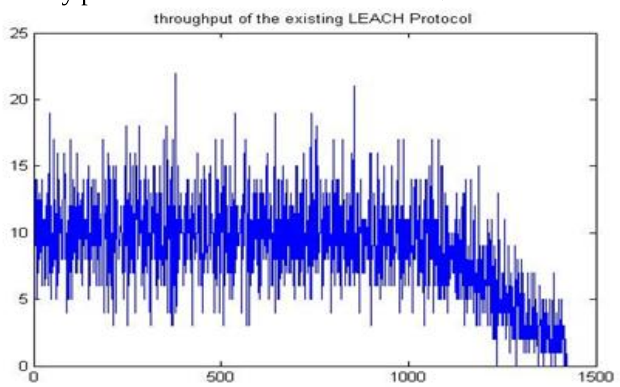

Fig.4 Throughput of LEACH Protocol

Figure 5 is showing the Packets that are sent to Base Station in Energy Leach Protocol during the lifetime of the Energy Leach protocol. It illustrates the throughput from 0 rounds to 2800 as 2800 is the overall lifetime of leach in our experiment. Here y axis shows the amount of packets sent during running time. It is clearly shown that the packets goes down rapidly recently after the first node dead, which clearly shows the benefits of the stability period of wireless sensor network. However it also shows the progress in terms of

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network life time and stability period than the simple leach protocol.

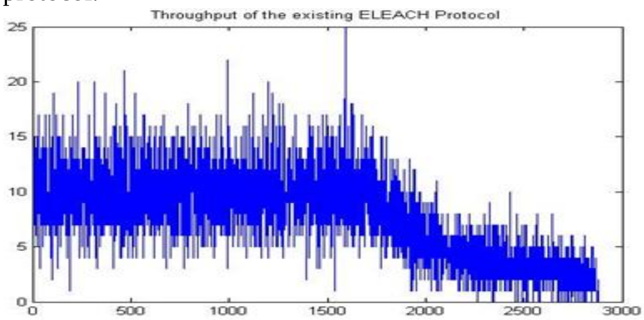

Fig.5 Throughput of eLEACH Protocol

Figure 6 is showing the Packets that are sent to Base Station in Energy Leach Protocol during the lifetime of the SEP protocol. It illustrates the throughput from 0 rounds to 3350 as 3350 is the overall lifetime of leach in our experiment. Here y axis shows the amount of packets sent during running time. It is clearly shown that the packets goes down rapidly recently after the first node dead, which clearly shows the benefits of the stability period of wireless sensor network. However it also shows the progress in terms of network life time and stability period than the simple leach or eLeach protocol.

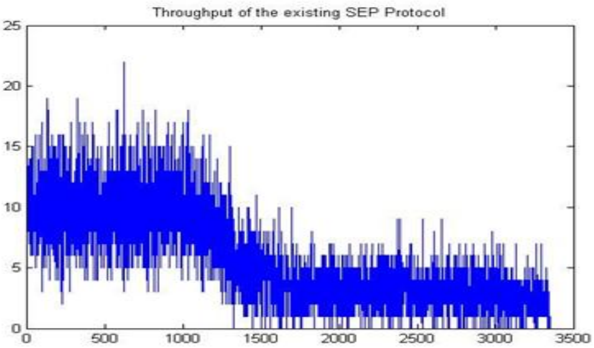

Fig.6 Throughput of SEP Protocol

Figure 7 is showing the Packets that are sent to Base Station in Energy Leach Protocol during the lifetime of the ESEP protocol. It illustrates the throughput from 0 rounds to 3414 as 3414 is the overall lifetime of leach in our experiment. Here y axis shows the amount of packets sent during running time. It is clearly shown that the packets goes down rapidly recently after the first node dead, which clearly shows the benefits of the stability period of wireless sensor network. However it also shows the progress in terms of network life time and stability period than the simple leach, Eleach SEP protocol.

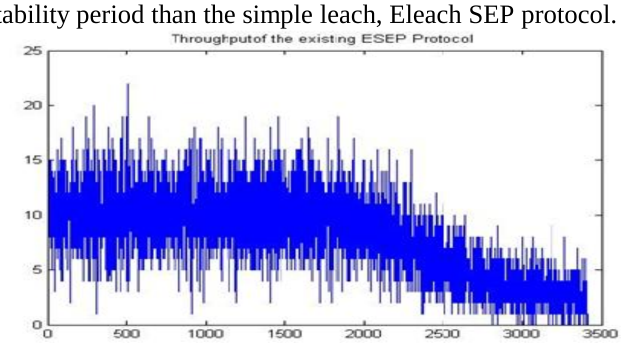

Fig.7 Throughput of ESEP Protocol

Figure 8 is showing the Packets that are sent to Base Station in Energy Leach Protocol during the lifetime of the proposed SEP protocol. It illustrates the throughput from 0 rounds to 3750 as 3750 is the overall lifetime of leach in our experiment. Here y axis shows the amount of packets sent during running time. It is clearly shown that the packets goes down rapidly recently after the first node dead, which clearly shows the benefits of the stability period of wireless sensor network. However it also shows the progress in terms of network life time and stability period than the simple leach, eLeach, SEP, ESEP protocol. And it is clearly shown that they are quite more than figure 4,5,6,7 which is proving that proposed protocol is better with respect to packets send to Sink.

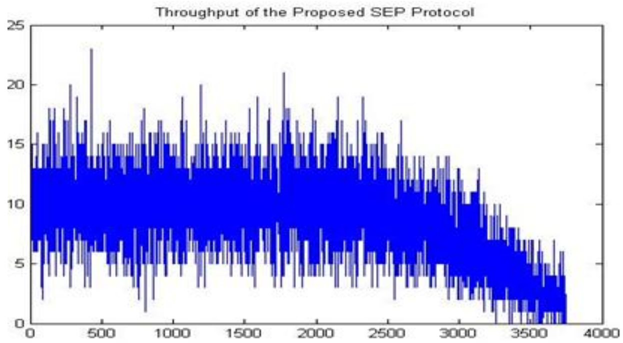

Fig.8 Throughput of Proposed SEP Protocol

E. Total Alive Nodes Evaluation:

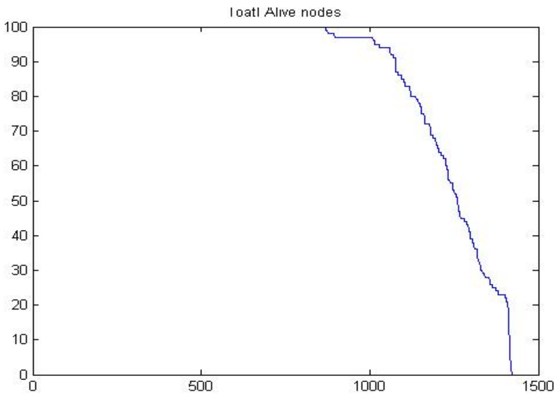

Fig: 9 Total Alive Nodes in Leach

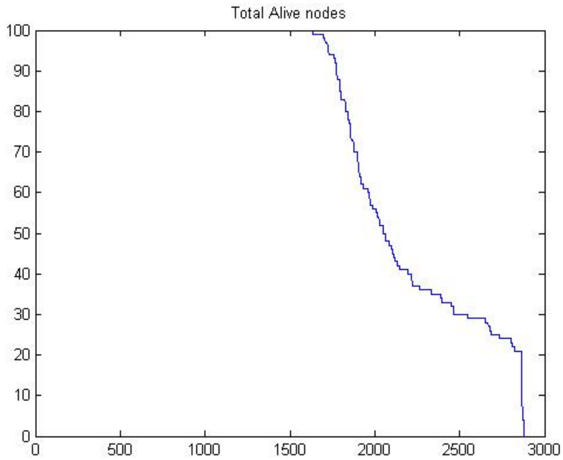

Fig: 10 Total Alive Nodes in eLeach

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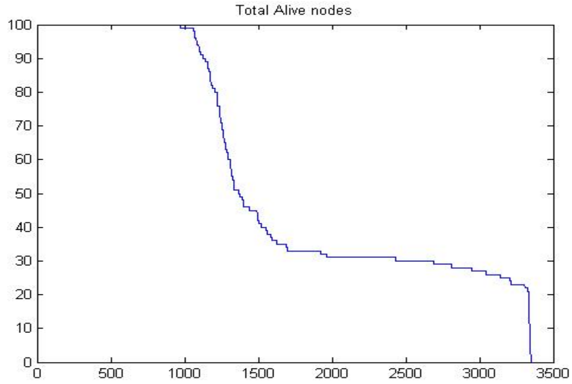

Fig: 11 Total Alive Nodes in SEP

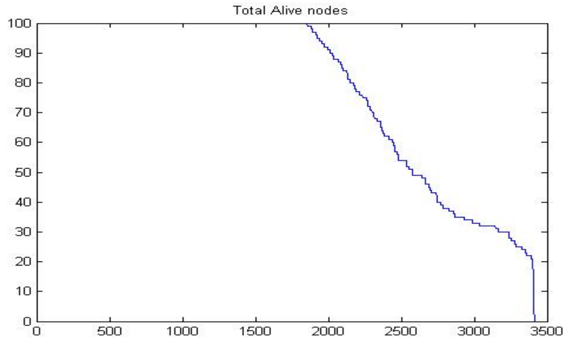

Fig:12 Total Alive Nodes in ESEP

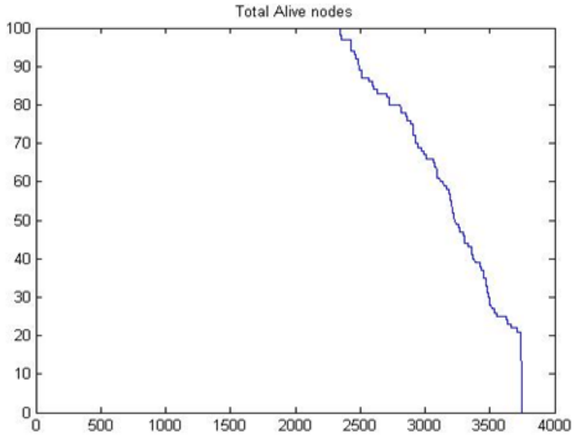

Fig: 13 Total Alive Nodes in Proposed SEP

Fig 9,10,11,12,13 illustrates the graph statistics of alive node with different number of rounds. In our proposed algorithm i.e fig 13 all the 100 nodes are alive till 2343 rounds and start dying thereafter. All the nodes completely die after3750 rounds and the network works satisfactorily till then. While in LEACH i.e fig 9 all the 100 nodes are alive till 900 rounds and start dying thereafter. All the nodes completely die after 1420 rounds. While in eLEACH i.e fig 10 all the 100 nodes are alive till 1560 rounds and start dying thereafter. All the nodes completely die after 2800 rounds While in SEP i.e fig 11 all the 100 nodes are alive till 969 rounds and start dying thereafter. All the nodes completely die after 3350 rounds. While in ESEPi.e fig 12 all the 100 nodes are alive till 1854 rounds and start dying thereafter. All the nodes completely die after 3414 rounds. Hence we can say that lifetime of network is increased in our proposed algorithm.

VII. CONCLUSION

The proposed algorithm has shown a significant improvement over LEACH, E-LEACH, SEP and Extended SEP. The only difference among existing protocols and proposed algorithm is that proposed algorithm selects a node as cluster head only if it has maximum energy among other nodes in cluster during run time. The proposed algorithm is seems to be justified as heterogeneity of WSN nodes is also considered by introducing the normal, advance and intermediate nodes. The comparisons of proposed algorithm with existing algorithm are better in every case. In near future we will extend this work by introducing the genetic algorithms to improve the decision making of cluster head selection.

REFERENCES

[1] Guisheng Yin1, Guang Yang1,2, Wu Yang1,2, Bingyang Zhang1,2, Wenjin Jin1,2 "An Energy-Efficient Routing Algorithm for Wireless Sensor Networks", International Conference on Internet Computing in Science and Engineering (IEEE) (2008),28-29 Jan; Harbin, pp.181-186.

[2] Haosong Gou and YounghwanYoo, "An Energy Balancing LEACH Algorithm for Wireless Sensor Networks", Seventh International Conference on Information Technology (IEEE) (2010),12-14 April; LasVegas, NV, pp.822-827.

[3] HeikkiKarvonen, Zach Shelby, Carlos Pomalaza-Rae.z, "Coding for Energy Efficient Wireless Embedded Networks", International Workshop on Wireless Ad-Hoc Networks (IEEE) (2004) , 31 May-3 June, pp.300-304.

[4] Hongjoong Sin, Jangsoo Lee, Sungju Lee, SeunghwanYoo, Sang yuck Lee, Jaesik Lee, YongjunLee, and Sungchun Kim, "Agent-based Framework for Energy Efficiency in Wireless Sensor Networks", World Academy of Science, Engineering and Technology 22, 2008, pp.305-309.

[5] Huu Nghia Le, Vyacheslav Zalyubovskiy, Hyunseung Choo "Delay-minimized Energy-efficient Data Aggregation in Wireless Sensor Networks", International Conference on Cyber-Enabled Distributed Computing and Knowledge Discover (IEEE) (2012),10-12 Oct; Sanya, pp.401-407.

[6] Linlin Wang, JieLiu , Wei Wang "An Improvement and Simulation of LEACH Protocol for Wireless Sensor Network", First International Conference on Pervasive Computing, Signal Processing and Applications (IEEE) (2010), 17-19 sept; Harbin, pp.444-447.

[7] Ma Chaw Mon Thein, ThandarThein "An Energy Efficient Cluster-Head Selection for Wireless Sensor Networks", International Conference on Intelligent Systems, Modeling and Simulation (IEEE) (2010), 27-29 Jan ; Liverpool, pp.287-291.

[8] Meenakshi Sharma and Anil Kumar Shaw "Transmission Time and Throughput analysis of EEE LEACH, LEACH and Direct Transmission Protocol: A Simulation Based Approach", Advanced Computing: An International Journal (ACIJ), Vol.3, No.5, September 2012.

[9] M M Islam1, M A Matin2, T K Mondol1 "Extended Stable Election Protocol (SEP) for Three level Hierarchical Clustered Heterogeneous WSN", (IEEE) (2012),18-19 June; London, pp.1-4.

ISSN: 2277-3754
ISO 9001:2008 Certified
International Journal of Engineering and Innovative Technology (IJEIT)
Volume 3, Issue 3, September 2013

[10] Reetika Munjal, Bhavneesh Malik "Approach for Improvement in LEACH Protocol for Wireless Sensor Network", Second International Conference on Advanced Computing & Communication Technologies (IEEE) (2012), 7-8 Jan; Rohtak, Haryana, pp.517-521.

[11] Rupesh Mehta, Abhishek Pandey& Pratik Kapadia "Reforming Clusters Using C-LEACH in Wireless Sensor Networks", International Conference on Computer Communication and Informatics (IEEE) (ICCCI -2012),10-12 Jan; Coimbatore, pp.1-4.

[12] Shuo Shi, Xinning Liu and XuemaiGu "An Energy-Efficiency Optimized LEACH-C for Wireless Sensor Networks", 7th International ICST Conference on Communications and Networking in China (CHINACOM) (IEEE) (2012),8-10 Aug; kun Ming, pp.487-492.

[13] Smaragdakis, Georgios, Ibrahim Matta, and Azer Bestavros. "SEP: A stable election protocol for clustered heterogeneous wireless sensor networks", Boston University Computer Science Department, 2004.

[14] Thu Ngo Quynh1, Kieu-Ha Phung2,3, Hoan Vu Quoc1 "Improvement of Energy Consumption and Load Balance for LEACH in Wireless Sensors Networks", (IEEE) (2012),15-17 Oct; Jeju, Island, pp.583-588.

[15] Vivek Katiyar, Narottam Chand, Gopal Chand Gautam,Anil Kumar "Improvement in LEACH Protocol for Large-scale Wireless Sensor Networks", (IEEE) (2011),23-24 March; Tamil Nadu, pp.1070-1075

[16] Yuhua Liu Yongfeng Zhao Jingju Gao "A New Clustering Mechanism Based On LEACH Protocol", International Joint Conference on Artificial Intelligence (IEEE) (2009), 25-26 April; Hainan, Island, pp.715-718.

[17] Zach Shelby, Carlos Pomalaza-Ra, Heikki Karvonen, and Jussi Haapola,"Energy Optimization in Multihop Wireless Embedded and Sensor Networks", Springer Science Business Media , International Journal of Wireless Information Networks, Vol. 12, No. 1, January 2005.

[18] Zhi-fengDuan, Fan Guo, Ming-xing Deng and Min Yu "Shortest Path Routing Protocol for Multi-layer Mobile Wireless Sensor Networks", International Conference on Net works Security, Wireless Communications and Trusted Computing (IEEE) (2009), 25-26 April; Wuhan, Huber, pp.106-110.