

Performance analysis of different types of LEACH protocol depending on various parameters

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Abstract-Wireless sensor networks are appearing as a show potential need intended for mankind. Although, such networks are still in do research phase though, they have high potential to be apply in approximately each field of life. A lot of do research is complete and a lot further is coming up to be standardized. Improved apply of Wireless sensor Networks (WSNs) in selection of application have enable the designer toward construct independent sensors, which know how toward be deploy at random, not including human being administration, for the reason of sense and communicate important data. Several energy-efficient routing protocols are intended used for WSNs base on clustering structure. In this paper, a to the point performance analysis of Modified LEACH (MODLEACH) and iMODLEACH protocol is undertake taking into consideration metrics of dead nodes, alive node, and packet transmits to cluster head, packet transmits to base station. We have proposed iMODLEACH protocol which is an addition to the MODLEACH protocol. Simulation results specify that iMODLEACH outperforms MODLEACH in terms of network life-time and packets transfer to base station. The mathematical analysis help to decide on such value of this parameter which can go well with a particular wireless sensor network application.

Key words: Wireless Sensor Network, Network Routing Protocol, MODLEACH Protocol, iMODLEACH Protocol, various parameters values results simulates in MATLAB

1. INTRODUCTION

Wireless Sensor Networks propose unique benefits and flexibility in conditions of low-power and low-priced quick consumption used for application which do not have need of human being supervision. Thus power efficiency is individual of the large amount essential issue as well as designing power-efficient protocol is critical for prolong the natural life. WSNs contain be measured for certain applications with limited power, reliable data transfer, short range communication, and sensibly low cost such sense application [1].

Among them LEACH protocol is generally use in WSN, because this protocol disperse the power in low level. What time the battery power is exhausted within these devices/nodes after that the network cannot be use and each and every one the nodes expend most of the energy though transmit the data. Therefore, to increase the lifetime of the network, every node have to do simply minimal work designed for transmit the data. Here all the nodes are group into the clusters, and in every cluster one of the nodes is assign at the same time as a Cluster Head (CH). LEACH algorithms have two phases [2]. They are set up phase and steady state phase. Setup phase is use to choose a CH and steady state phase is used to maintain the CH during the transmission of data. This work focuses on analyze the optimization strategy of routing protocols with respect to force consumption of sensor nodes in Wireless Sensor Network (WSNs).

In this paper, we contain initially consider MODLEACH protocol when reference and the hard and soft threshold values are fixed and analysis the performance of varies parameters. Nowadays, we contain consider MODLEACH protocol as the reference and considered such parameters like p (probability of choose a CH), s (software threshold value) and h (hard threshold value) which have been use in this protocol to additional improve the performance of the MODLEACH protocol. As our protocol out-performs the functionality of the protocol, therefore the name is specified as iMODLEACH (Improved Modified LEACH)[4]. We various the values of the p (probability), s (soft threshold value) and h (hard threshold values) parameters and analyze their effect on the performance of the network mathematically as well as after that verified those with the help of simulations. The results clearly specify that our protocol iMODLEACH outperforms MODLEACH in terms of network life span and packets transfer to base station. The study helps to choose such values of this parameter which can suit a particular wireless sensor network application.

2. Relative Works

Heinzelman, et.al [1] introduce a cluster algorithm for sensor networks; call Low Energy Adaptive Clustering Hierarchy (LEACH). LEACH forms cluster through use a distributed algorithm, wherever nodes construct independent decision without any central control. LEACH arranges the nodes in the network interested in cluster and choose one of them as CH. The operation of LEACH is divided into rounds. Each round begin through a setup phase when the clusters are structured, followed by a steady-state phase what time data is transfer from nodes to the CH as well as then to the BS.

Enhanced LEACH Protocol used for Wireless Sensor Networks is proposed by A.Koucheryavy, Ahmed Salim, and Walid Osamy in 2013 [2] , workings in Wireless sensor networks (WSNs) to be collected of several low cost, low power devices with sense, local processing and wireless communication capability. In this paper, the cluster routing protocol LEACH (Low-Energy Adaptive Clustering Hierarchy) is consider and improved.

Modified LEACH Energy Efficient Wireless Networks Communication be proposed through Abuhelaleh *et al.*[3].The operation of the Mod-LEACH occur in rounds, as well as rounds are classify into two kinds, the full transmission round moreover the half transmission round. Modified-LEACH provides large sensor networks among high energy saving, and high level of performance, more than nine times better than LEACH and twice better than TCCA These results explain with the purpose of our proposal provide a well-organized solution for high performance sensor networks communication.

iMOD LEACH: improved MODified LEACH Protocol used for Wireless Sensor Networks proposed through S.Ahmed *et al* [4]. In this research, authors contain proposed iMODLEACH protocol which is an addition to the MODLEACH protocol. Simulation results show so as to iMODLEACH outperforms MODLEACH in terms of network life-timeand packet transfer to base station.

Mahmood *et al* [5] modified individual of the mainly important WSNs routing protocol LEACH when modified LEACH (MODLEACH) through introduce efficient CH replacement scheme and dual transmit power level. The modified LEACH, within comparison through LEACH outperformed it use metrics of CH formation, throughput as well as network life. Finally a brief performance analysis of LEACH, MODLEACH, MODLEACH with Hard Threshold (MODLEACHHT) and MODLEACH with Soft Threshold (MODLEACHST) be undertake consider metrics of throughput, network life and CH replacement.

3. PROBLEM DEFINITION

Heinzelman, et al. [1] Low Energy Adaptive Clustering Hierarchy (LEACH) be a cluster-based protocol, during which the role of a member node within the cluster be toward sense the neighboring environment with transmit the sense data toward a cluster head. The cluster head at that time aggregate as well as transfer the sense data to the BS during order to reduce the amount of information that should be present transmit to the BS, which drain out extra energy of the cluster head at the same time as compare toward the other nodes. The protocols at random selects a small number of sensor nodes as cluster-heads moreover rotate this role toward consistently distribute the power load amongst the sensors into the network.

LEACH use a TDMA/code-division multiple access (CDMA) MAC toward reduce inter-cluster and intra cluster collisions. After a specified period, randomized rotation of the role of cluster-head is conduct thus to identical power dissipation within the sensor network be obtain. A parameter of p is introduced which reflect the probability of choose a cluster head with the member nodes of a cluster.

4. PROPOSED MOD LEACH PROTOCOL

These protocols modify LEACH, when it introduces an efficient CH replacement technique with dual transmit power level. The CH is changed by every round. In every one round, CHs are changed as well as entire cluster formation procedure is repeated. If CH have not use up much power and have extra power than the threshold, it will happen to CH used for the follow round also. By this method, power lost inside routing data for new CH and cluster formation be save. Otherwise, it will be real changed within the same method as in LEACH. Additional, soft and hard thresholds be use toward improve the performance even more [8].

The modified LEACH, within comparison through LEACH outperformed it use metrics of CH creation, throughput and network life. Afterwards, hard and soft thresholds are implementing happening MODLEACH to boost the performance still additional. Finally a brief performance study of LEACH, MODLEACH, MODLEACH with Hard Threshold (MODLEACHHT) and MODLEACH with Soft Threshold (MODLEACHST) was undertake allowing for metrics of throughput, network life furthermore CH replacement.

. In this research, three extremely important parameter p (probability of choosing a CH), s (soft threshold value) and h (hard threshold value) be consider furthermore their impact going on net performance of the network be study and analyzed; both systematically and among

simulation. MODLEACH utilize these parameter through select their value fixed by $p=0.1$, $s=2$ and $h=100$. We completed certain variation into every one these parameter with study their behavior on the performance of the network as well additional parameter.

4.1 Simulation Results

The mathematical analysis be additional established with simulations on MATLAB within which the following parameter be set as well as a variety of graphs were plotted which prove with the aim of our protocol MODLEACH outperforms.

Table-1: Network parameter through specific value

Network Parameters	Values
Network sizes	100*100
Initial power of sensor nodes	0.5J
Probability of cluster head	0.1%
Packet sizes	4800 bits
Transceiver inactive energy computation	50nJ/bit
Data aggregation energy	5*0.000000001 J
Amplification energy (cluster to BS) $d>d_0$	10*0.000000000001J
Amplification energy (cluster to BS) $d<d_0$	0.0013*0.000000000001J
Number of nodes	100

Network Performances Parameters

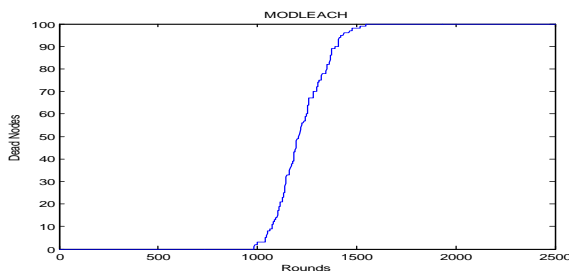


Fig-1: Dead node against rounds

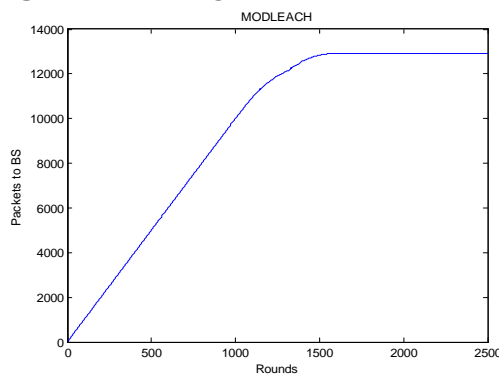


Fig- 2: Packet transmit toward base station

The plot within fig-1 reflects the number of dead nodes against number of rounds. The network life time define the same as the moment in time for which the network remains efficient as well as till each and every one the nodes die and stop transmission.

Plot in fig-2 to indicate the packet send to base stations against round used for which the network is functioning.

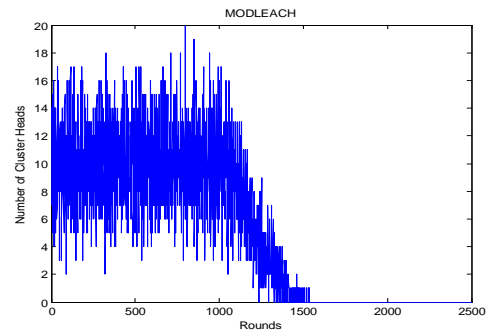


Fig- 3: Counting the cluster head

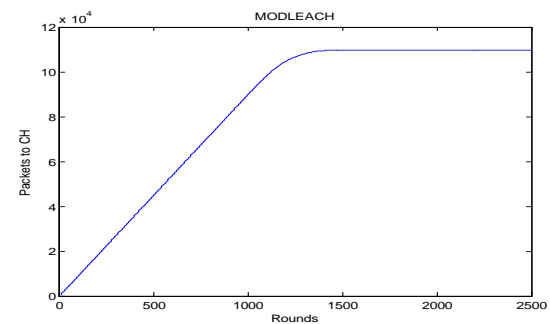


Fig-4: Pacakets transmit to cluster head

The plot within fig-3 to specify the count up of cluster heads through value of $p=0.1$ (probability of choose a cluster head) and fig-4 represent the packet transfer toward cluster heads within various rounds of the network taking interested in thought the location of sink. i.e. going on the origin on x-axis , y-axis ,in middle of network.

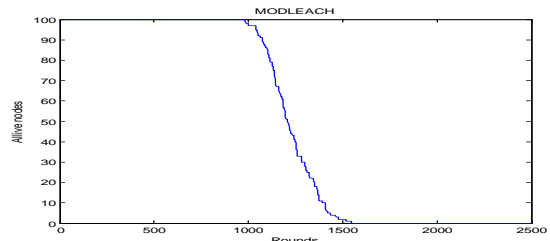


Fig- 5: Count of alive nodes

In this fig-5 toward stand for reflect the number of alive nodes versus the number of rounds in use within a network designed for its completion or till the last node death.

4.1 Problem definition of MOD LEACH protocol

Some flavor of LEACH has crop up as its origin furthermore everyone individual of them have given away certain improvement within special features and parameter of LEACH. MODLEACH [8] exist one of those protocols although this protocol, like other protocols, have not consider the role of p going away on top of the performance of the protocol, usually the permanence of the network, packet transfer to CH and BS etc. To some extent varying the value of p the same as well as h parameters for sure explain considerable improvement contained by the performance of the system. Through this perform research, certain mathematical analysis be complete toward find the role of these parameter with toward come up all the way through certain nominal value which must exist choose still consider the application domain of the network. Experimentation be complete into MATLAB to find the accuracy of the mathematical analysis done as explain inside the section below.

During that case by present toward brief introduction of iMOD LEACH protocol at the same time as well as simulation results within MATLAB.

5. PROPOSED iMOD LEACH PROTOCOL

Within this section we will talk about the iMODLEACH protocol in detail. This protocol is mainly base going on MODLEACH [3] protocol which be itself a stimulation of the LEACH [7] protocol.

The main region be further divided into sub regions which be usually referred toward when, clusters. Every one cluster contains number of nodes of which one of them be performing as the CH. Every CH receives data from each and every one of its client nodes with performs several necessary iteration for compression. All CH's forward the compressed data to Base Station. Every node is considered nomadic otherwise stationary inside their respective cluster as well as hence, here is no abrupt change into network topology.

iMOD LEACH protocol vary the value of the p , s and h parameters with analyze their effect going on the performance of the network mathematically also then verified those with the help of simulation. All CH receive data from each and every one of its client nodes with performs some necessary iteration use for compression. Every CH's forward the compressed data to Base Station. Initial of every varying the value of p from 0.1 to 0.9, different experiment was perform within MATLAB as well as the follow reading be noted:

Table-2: Variant of p with its effect taking place Stability with Network life span

Probability (p)	Rounds	Packet sent to base station	Packet sent to cluster head	First dead node
0.1	2500	12280	102663	986
0.2	2500	22941	89577	815
0.3	2500	33781	77745	745
0.4	2500	37745	74454	641
0.5	2500	54374	54054	449
0.6	2500	56843	56556	485
0.7	2500	76477	32626	308
0.8	2500	90166	22545	302
0.9	2500	99744	11008	274

Here this table explains with the aim of varying the value of p from 0.1 to 0.9, after that packet sent toward base station increase, packet sent to cluster head decrease and first dead node also be decrease but the stability of network increase. With the help of these results, we know how to suppose that there is a trade-off among the maximum round traverse with the first dead node of the network otherwise into other terms the stability of the system, going on selection of a particular value of p .

During the final set of experiment, we varied the value of hard threshold h through keep the p constant and after that make p variable, the experiment be repeat once more. The follow set of data be generate going on this basis:

Table-3: Variation of p and h with its effect going on Stability and Network time

P	H	First Dead node of the network
0.1	100	986
0.1	200	984
0.1	300	842
0.1	400	797
0.1	500	986
0.1	600	721
0.1	700	967
0.1	800	838
0.1	900	980
0.2	100	815
0.2	200	786
0.2	300	667
0.2	400	718
0.2	500	815
0.2	600	753
0.2	700	642
0.2	800	709
0.2	900	694

The table reveal to used for a fix value of $p=0.1$, after that the first dead node decrease constantly through varying the value of h as of 100 to 400, it over again increase the similar value of first dead node value next to $h=500$ as that $h=100$ and then decreases again till $h= 800$ and the same performance be repeat used for high value of h with fixing the value of p by various other standard.

Therefore the selections of h at 100 or 500 give us the similar performance however at values of 200, 300 and 400; we find a give and take again among the stability of the network as well as the life span of the network which be all over again focused on the application within which the network be desired.

Therefore, taking keen on thought each and every one these details with information, we can correctly adjust the value of parameter p , s and h with surely the performance of the MODLEACH be considerably improved used for different environment of application.

5.1 Simulation Results

The mathematical analysis be further established with simulation going on MATLAB into which the follow parameters be set along with a variety of graph be plot which prove with the purpose of our protocol iMODLEACH outperforms MODLEACH protocol within certain respect.

Table-4: Network Parameters through Specified value

Network Parameters	Values
Network sizes	100*100
Initial energy of sensor nodes	0.5J
Packet sizes	4800 bits
Transceiver idle energy computation	50nJ/bit
Data aggregation energy	5*0.000000001 J
Amplification energy (cluster to BS) $d>d_0$	10*0.000000000001J
Amplification energy (cluster to BS) $d<d_0$	0.0013*0.000000000001J
Number of nodes	100
Amplification energy (intra cluster communication), $d\leq d_1$	$E_{mp} / 10 = E_{mp1}$
Amplification energy (intra cluster communication), $d\geq d_1$	$E_{fs} / 10 = E_{fs1}$

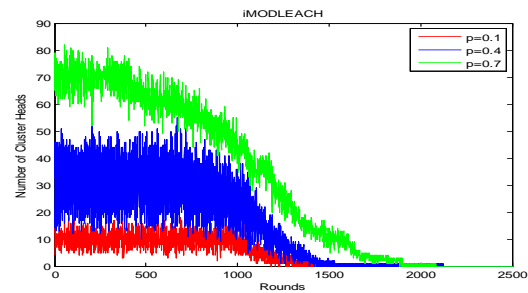


Fig-6: Count of cluster head through special p value

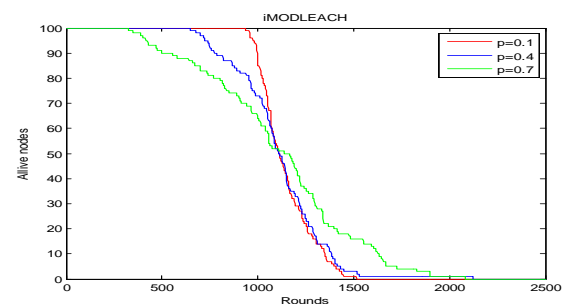


Fig-7: Count of alive node through different p value

The fig-6 represents the count of cluster heads through the variant into the value of p (probability of choosing a CH). The plot clearly specify to used for the value of $p=0.1$, the CHs generate be also less where it is too high (approx reaching 80 in the first 200 rounds); a number too big which be able to throw in a lot toward the utilization of power; therefore a nominal value used for the selection of p use for a reasonable generation of CHs is $p=0.4$.

The fig-7 reveals the number of alive nodes against the number of rounds in use during a network for its completion otherwise till the last node death. The plot be plotted varying the value of p . Used for $p=0.1$, the stability period (i.e. the death of the first node following the network starts its functionality) be quite improved however the network dies fairly early at around 1500 rounds. For $p= 0.8$, the stability is quite less other than the final rounds be going away up to 2100 rounds, where used for $p=0.4$, we obtain an intermediate, average as well as suitable values within terms of permanence period with maximum rounds traverse.

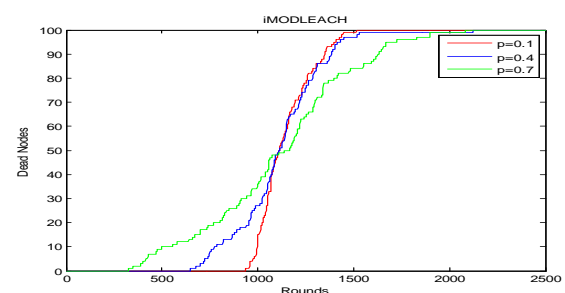


Fig-8: Dead nodes against rounds

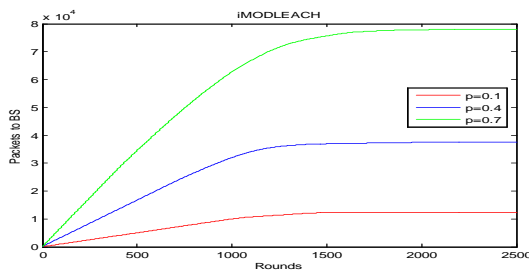


Fig-9: Packet sent to base station through different p values

The plot within the fig-8 toward specify, it be define the same as the time used for which the network remains functional with till each and every one the nodes die and stop transmission. Then various the value of p and decrease the value first dead node but the network lifetime increase.

The plot into fig-9 are plot for different value of p taking keen on thought the packet send to base station against the rounds for which the network is work. The plots clearly reveal so as to by the rising value of p from 0.1 till 0.8, the number of packets send to base station is suddenly rising and similar be the cases used for the number of packets send to cluster head as of different nodes in a cluster with the increase in the values of p . Other than once more present be trade-offs among different parameters involved through the variations in the value of p . Therefore such value is choosing which can balance other parameter as well.

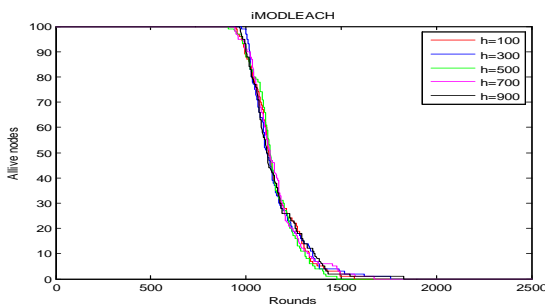


Fig-10: Number of alive node of various value of h

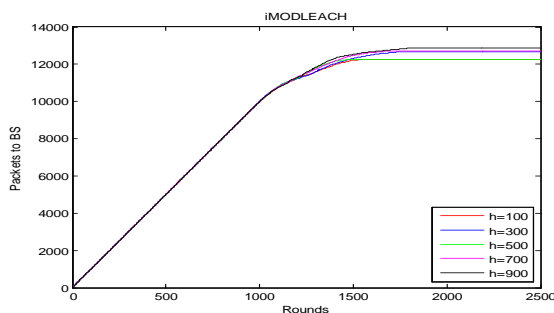


Fig-11: Packet sends to base station through different value of h

The plot into fig-10 be drawn through varying the value of hard threshold h maintenance p at the same time as constant on some small value with note the presence of alive nodes through the course of the network; however it be establish that no major variation be found within the graph of various quantity. Similar experimentation is also perform varying the value of soft threshold s and over again the stability period be not found toward contrast greatly. Therefore it is concluded to the soft and hard thresholds have no profound effect happening the stability period of the network.

Yet again an experimentation perform through maintenance the value of p constant at 0.1 and varying the value of h and observe the variation within packets send to the base station is shown graphically into fig 11. Furthermore much surprising results reveal to the value of packet send to BS regularly reduce from $h=100$ to $h=400$, after that over again increase at $h=500$ as well as the repeat performance be experiential from $h= 500$ to $h=800$. Therefore a trade-off was again established between p and h . The experiment be repeat through change the value of $p=0.2$ as well as then over again varying the value of h .

6. CONCLUSION

In this paper, we furthermore propose MODLEACH, a new variant of LEACH so as to be able to further exist utilize within other clustering routing protocols used for better efficiency and simulate the results in MATLAB moreover problem discussion and then we introduction iMOD LEACH protocol which be an extension to the MODLEACH protocol. Simulation results specify that iMODLEACH outperforms MODLEACH in terms of network life span and packet transfer toward base station; so as to can further exist utilize inside other clustering routing protocols for improved efficiency. Therefore taking keen on thought each and every one these facts and figures, we can properly adjust the value of parameter p , s and h and surely the performance of the iMODLEACH is significantly improved used for special environment of application.

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