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AN APROACH COMBINING LEACH-PEGASIS PROTOCOLS FOR WIRELESS SENSOR NETWORKS: (CLP-PROTOCOL)

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Abstract

In wireless sensor networks (WSN), minimizing the energy consumed by the sensor node when transmitting or receiving data between nodes or change information with the base station (BS) is very important to maximizes the lifetime of networks for long-term monitoring time, for that energy consumption is the major constraint that influences the architecture of the sensor network, in general the sensor network is limited in energy. In most cases, change the battery of sensor is not possible, this means that the lifetime of a sensor depends greatly on the lifetime of the battery.To solve this problem, it is necessary to choose routing protocols that consume less energy, namely hierarchical routing protocols. The aim of this paper is in first to evaluate the performance of two hierarchical routing protocols in terms of energy consumption by each node in sensor network, namely Protocols Low-Energy Adaptive Clustering Hierarchy (LEACH) and protocol Power-Efficient Gathering in Sensor Information System (PEGASIS), secondly this paper proposes our method routing protocol proposed for the (WSN) based on LEACH and PEGASIS, our proposed method is a combination of LEACH and PEGAIS protols (CLP-protocol).

Keywords:

WSN;
Base Station;
BS;
LEACH;
PEGASIS;
CLP;
Energy.

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1. Introduction

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Recently, advances in wireless communication and digital electronics have led to the development of Wireless Sensor Network (WSN), This new technology promises to revolutionize our way to live, work and interact with the physical environment around us [1]. WSN has been applied in manyfields such as military investigation, medical treatment, and industry management [2].

In Sensor networks the important constraint is the energy consumption by each node that influence the lifetime of a network, because the nodes in WSNs are usually powered by batteries with finite capacity and it is always impossible to replenish the power[3], and the failure of the energy sensor can significantly modify the topology of the network and impose an expensive reorganization of the network[4]. Therefore, the applications are hindered by limited energy supply, and one design challenge in sensor networks is to save limited energy resources to prolong the network lifetime [5], in the other many characteristics of WSN must be considered for efficient deployment of the network, to know: Low cost, Energy efficient, computational power, communication capabilities security and Privacy, distributed sensing and processing, dynamic network topology, Self-organization, Multi-hop communication, Application oriented, Robust Operations and Small physical size [6].

Sensor networks have emerged as a promising tool for monitoring the physical worlds, utilizing self organizing networks of battery-powered wireless sensors that can sense, process and communicate, in the other a wireless sensor network (WSN) consists of a large number of small-sensor nodes used to monitor areas, collect and report data to the base station (BS), and each node serves as transmitter and router, these sensors (node) are used to control an environment and transmit the captured data to the base stations [7].

Therefore, how to prolong the network lifetime is an important and challenging issue, which is also the focus of designing the WSN routing protocol. Many routing protocols have been proposed for WSN. Based on the network topology, they can be classified as plane protocols and hierarchical protocols. As we all know LEACH and PEGASIS is a typical hierarchical routing protocols using to resolve the a problems of energy [8].

In this paper, we will concentrate on the energy constraint by introducting the model of energy comsumption in wireless sensor network to show the importante role of constrainte distance separed betwen the transmitter and the receiver entity exchanged a data .

Section 3 presents the details methods LEACH, PEGASIS and our proposed method (CLP) to send a data to BS and minimize energy consumption.

Section 4 detailed the results simulation using Basic LEACH, Basic PEGASIS and our CLP proposed method algorithm in Matlab simulink.

Finaly section 5 and 6 concludes a comparative between results simulation of LEACH and PEGASIS with our CLP proposed and our perspective for future works.

2. Model Energy Comsumption in wireless sensor network

In wireless sensor network the energy consumed by a sensor node is essentially due to the following operations: capture, processing and data communication, to maximize the lifetime of the sensor network, it is necessary to think about the strategy that allows the efficient use of energy consumed by each node used in the transmission or reception between all the nodes constituted the wireless sensor networks,in the order, the communication energy represents the largest portion of the energy consumed by a sensor node[9].

Heinzelman and al [8] propose a radio model of energy consumption. Thus, the energies needed to send E_{Tx} (s, d) and receive E_{Rx} (s) messages are given by:

To send s bit message to a receiver far from distance d, the transmitter consumes:

$$E_{Tx}(s,d) = E_{Tx}elec(s) + E_{Tx}amp(s,d) = (E_{elec} * s) + (E_{amp} * s * d^2) \qquad (1)$$

To receive a bit message, the receiver consumes:

$$E_{Rx}(s) = E_{Rx}elec(s) = (E_{elec} * s) \qquad (2)$$

Where E_{elec} and E_{amp} respectively represent the electronic transmission energy and the amplification energy.

The following figure 1 bellow illustrates the model of energy consumption when data is exchanged between two entities located at a distance d from each other [10].

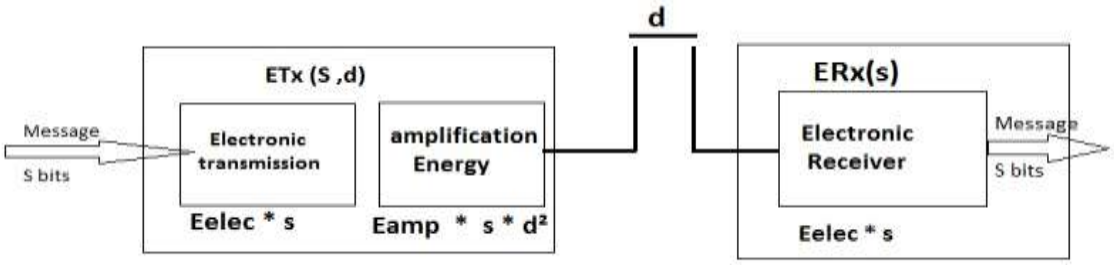

Figure 1. Energy Comsumption Model in wireless sensor network

In formula (1) and (2) whe noted that the distance between the transmitter and the receiver entity increases the energy consumed during the exchange operation between two communicating entity when d is very small, that is why several protocols have been devoloped to minimize this transfert distance to the base station to increase the lifetime of sensor network.

The Formula distance between each nod and base station is presented in formula 3 bellows:

$$Dis_k = \sqrt{(Xbs - x_k)^2 + (Ybs - y_k)^2} \qquad (3)$$

Where Dis_k the distance of each node-k from the base station.

Xbs and Ybs are the coordinates of the base station

x_k and y_k are the coordinates of the each k-node

In this paper we will focus on the strategy of two hierarchical protocols LEACH and PEGASIS on which we based to propose our new method called CLP (combination LEACH-PEGASIS) and detailed our CLP proposed.

3. Detailled of LEACH and PEGASIS Protocols in WSN

3.1. Detailled of LEACH Protocol

Protocol LEACH considered one of the first hierarchical routing approaches based on clustering, the idea behind LEACH is to form clusters of nodes sensors depending on the strength of the received signal and to use local cluster heads (CH) as routers to route data to the base station [11].

The primary objective of this protocol is to choose sensor nodes as CHs by rotation technique, hence the most energy dissipation in communicating with the base station is spread to all sensor nodes in the network [12]. To achieve this objective LEACH protocol performs local data fusion in order to compress the information gathered by the clusters before sending it to the sink(BS), so that reducing energy waste and enhances the system lifetime. Figure 2 shows the basic topology of LEACH protocol [13].

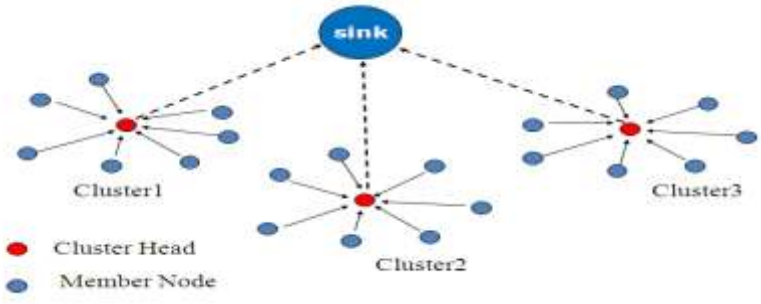

Figure 2. Basic topology of LEACH protocol

The operations of LEACH are generally separated into two phases: the setup phase and the steady-state phase.

In the setup phase, CHs are selected and clusters are organized. In the steady-state phase, the data transmissions to the BS take place. The role of the CH is assigned by the node getting a random number between 0 and 1. If the number is less than the threshold values T (n), the node becomes a CH for the current round [14] ,the following equation (4) bellow shows how to compute T(n) :

$$T(n) = \begin{cases} p/(1-p*(r*\bmod(1/p)) & if \quad n \in G \\ 0 \end{cases} \qquad (4)$$

Where n is the given node, P is the predetermined percentage of CHs (P = 5%), r is the current round, and G is the set of nodes that have not been selected as CHs in the last 1/P rounds.

3.2. **Detailled of PEGASIS Protocol**

In PEGASIS the nodes will be organized so that they form a chain, and will have need to communicate with only their closest neighbors and take turns in communicating with the base station as shown in figure 3 beloow. Indeed, PEGASIS has two main objectives. First, increasing the lifetime of each node by using collaborative techniques and thus increase the lifetime of the network. Secondly, allow only the local coordination between neighboring nodes so that the bandwidth consumed in the communication is reduced [15].

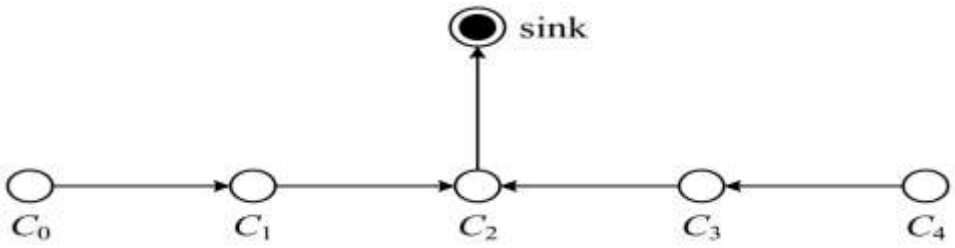

Figure 3. Basic topology of PEGASIS protocol

In the above figure 3. Greedy chain Algorithm C0, C1, C2, C3 and C4 are nodes. Where node C0 and C4 is for away from Base station. Neighbour nodes of node C0 are node C1 and neighbour nodes of node C4 are node C3. Now node C0 can able to get connected with C1 and node C4 can able to get connected with C3, C1 and a3 can able to get connected with C2 and finally C2 get connected with base station.

3.3. **Detailled of CLP (Combined-LEACH- PEGASIS) Protocol proposed**

Generally PEGASIS protocol uses one CH that communicates with the BS [16], but in our Method Proposed whe combined the thechnique using Pegasis Protocol and LEACH technique,

In CLP Protocol proposed, firstly we used the technique LEACH protocol to select CH in the architecture network, secondly constructed a chaine betwhen all cluster formed by LEACH protocol using technique PEGASIS Protocol to have finaly one node is responsible to send data to BS, The figure 4 and figure 5 bellow show respectively our new opology of proposed method CLP and all steps of our method proposed to minimize the energy consumption of each node and increase the lifetime of network sensor:

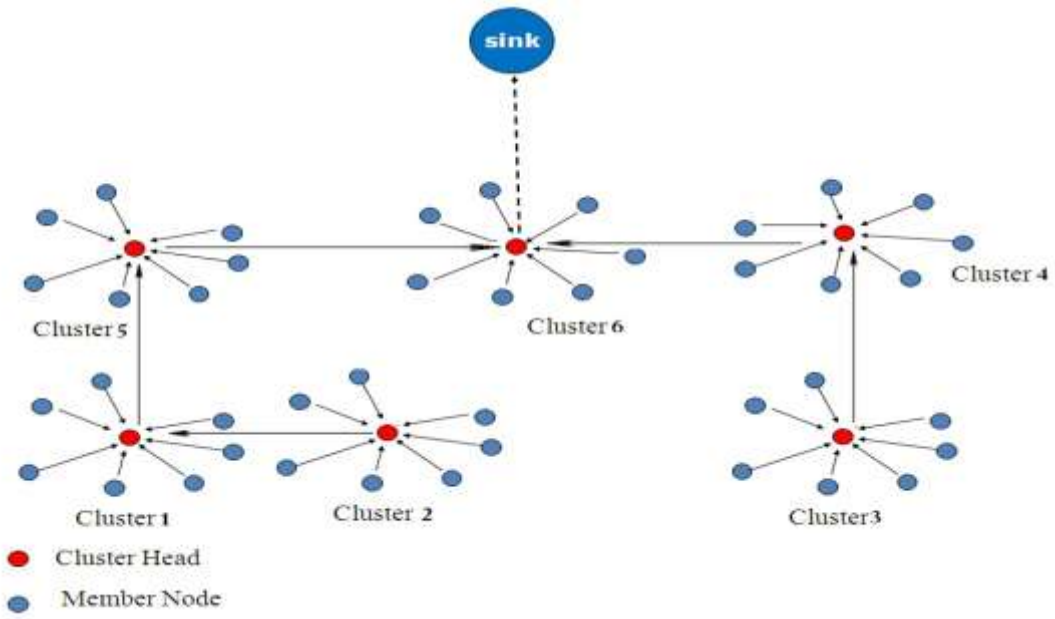

Figure 4. Topology of proposed method CLP

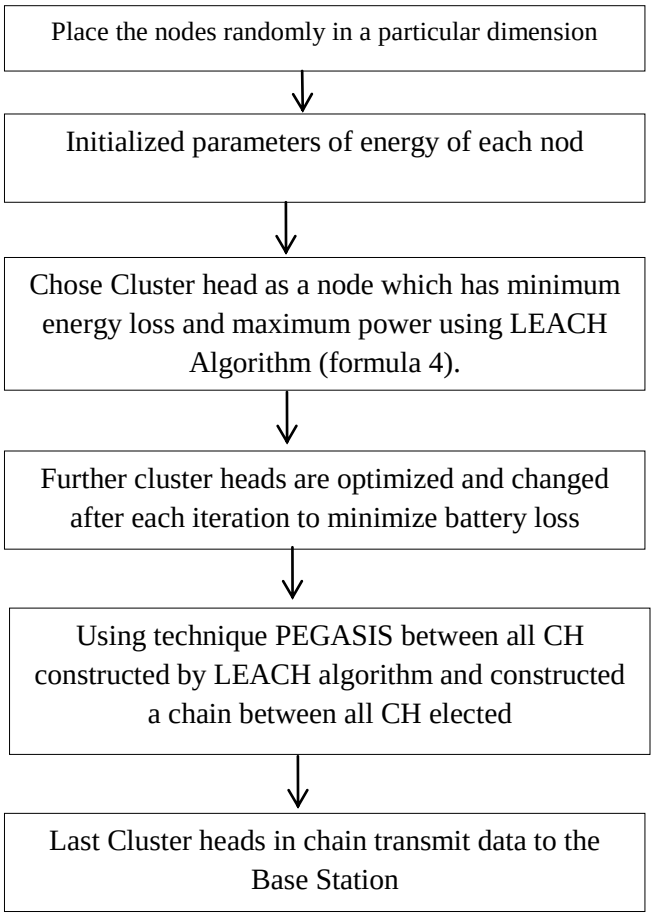

Figure 4. Step of proposed methods

4. Results Simulation Basic LEACH, PEGASIS and our CLP Proposed Method

4.1. Parameters of simulation Protocols LEACH, PEGASIS and CLP Proposed Method

To Compar the Basic LEACH and Basic PEGASIS protocols with our CLP proposed using Matlab Simulink we chose the same parameters simulation shown in the table 1 bellow and we noted the number of died nods in 500, 1000 and 1500 rounds:

Table 1. The simulation Parameters of LEACH, PEGASIS and CLP Proposed Method

Description	Number of nodes	Simulation Area M^2	Initial Energy (J)	Energy transmission (J)	Energy reception (J)	Simulator	Rounds
Specification	100	(100,100)	0.15	$50*10^{-9}$	$50*10^{-9}$	Matlab	1500

4.2. Simulation Results using Basic LEACH Protocol

The figure 5 bellow show the simulation results representing the number of dead node after number of rounds (1500 rounds) using Basic LEACH protocol.

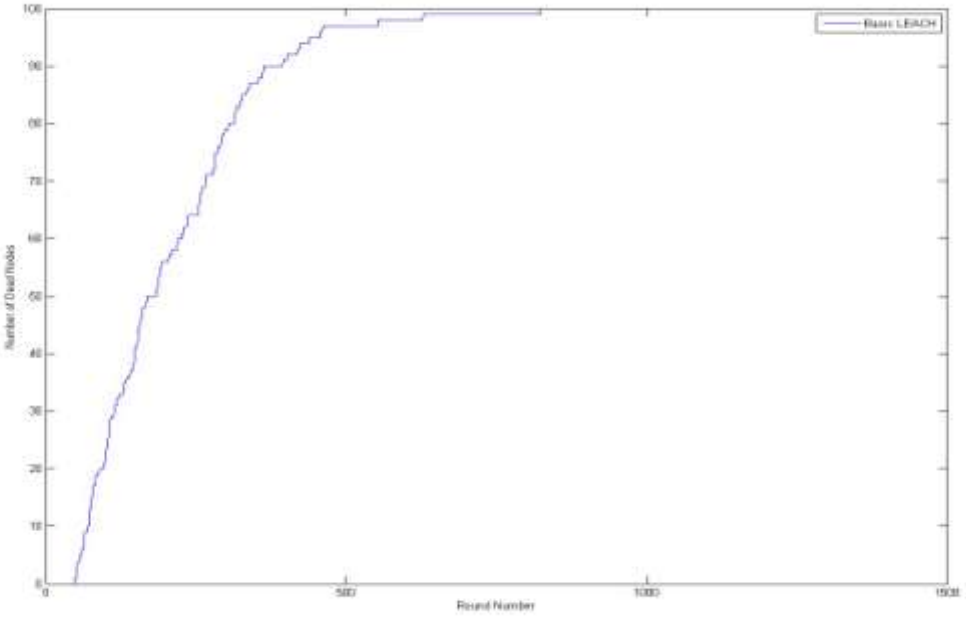

Figure 5. Number of node dead after 1500 rounds using LEACH Protocol.

4.3. Simulation Results using Basic PEGASIS Protocol

The figure 6 bellow show the simulation results representing the number of dead node after number of rounds (1500 rounds) using Basic PEAGSIS protocol

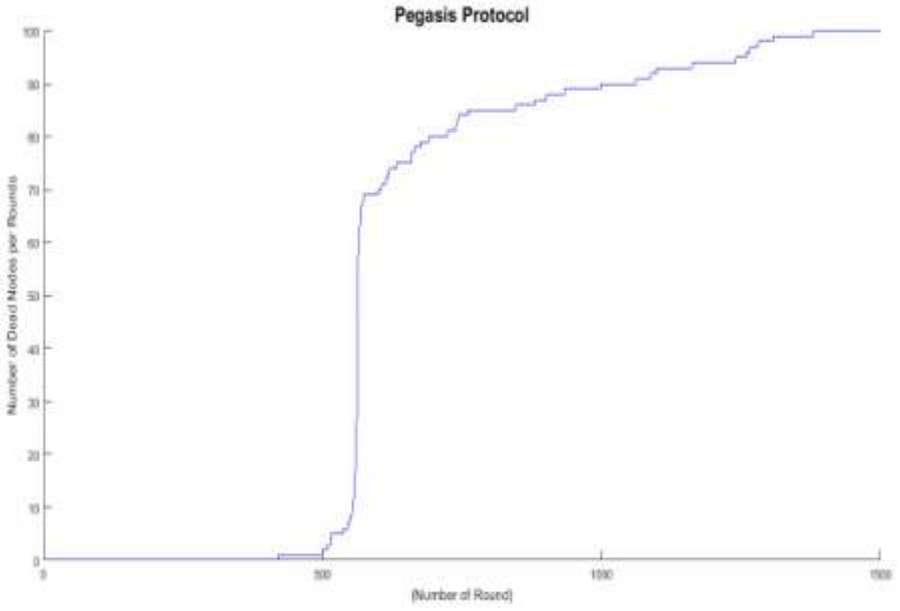

Figure 6. Number of node died after 1500 rounds using PEGASIS Protocol.

4.4. Simulation Results using CLP Protocol Proposed

The figure 7 bellow show the simulation results representing the number of dead node after number of rounds (1500 rounds) using our CLP protocol Proposed

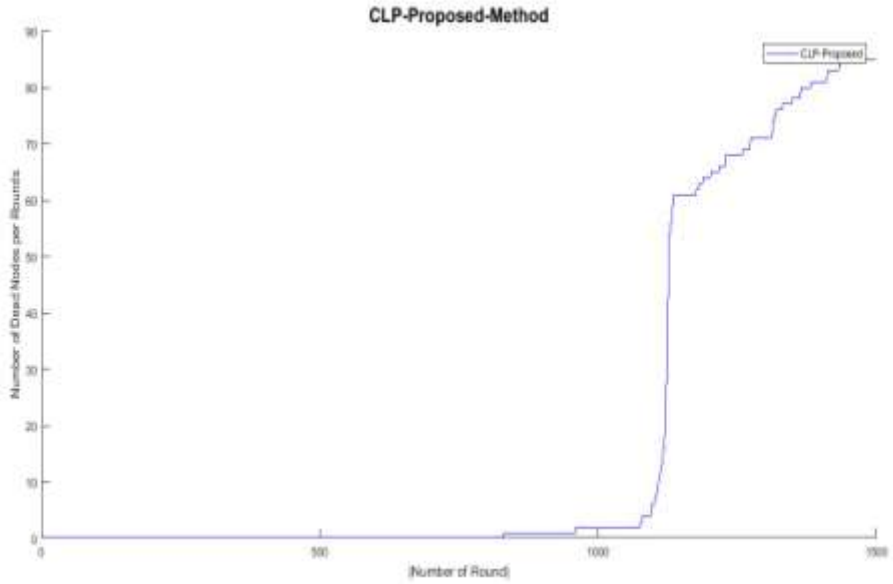

Figure 7. Number of node dead after 1500 rounds using proposed method CLP

5. Descusion Results Simulation

To compare a performance of our proposed approach called CLP with the LEACH and PEAGSIS protocols based on result simulation presented in figures 5, 6 and 7above we have claclue the number of dead nod for the numbers of round 500, 1000 and 1500, this results clearly show that there is an extension of the network lifetime using our CLP method more than basic LEACH and basic PEGASIS as shown in table 2 and figure 8 bellows:

Table 2. Number died nods in 500, 1000 and 1500 rounds using Basic LEACH, Basic PEGASIS and our CLP Method

Number Rounds	500 rounds			1000 rounds			1500 rounds		
Protocols	LEACH	PEGASIS	Propsed-CLP	LEACH	PEGASIS	Propsed-CLP	LEACH	PEGASIS	Propsed-CLP
Number Died Nod	95	5	0	99	90	5	100	100	82

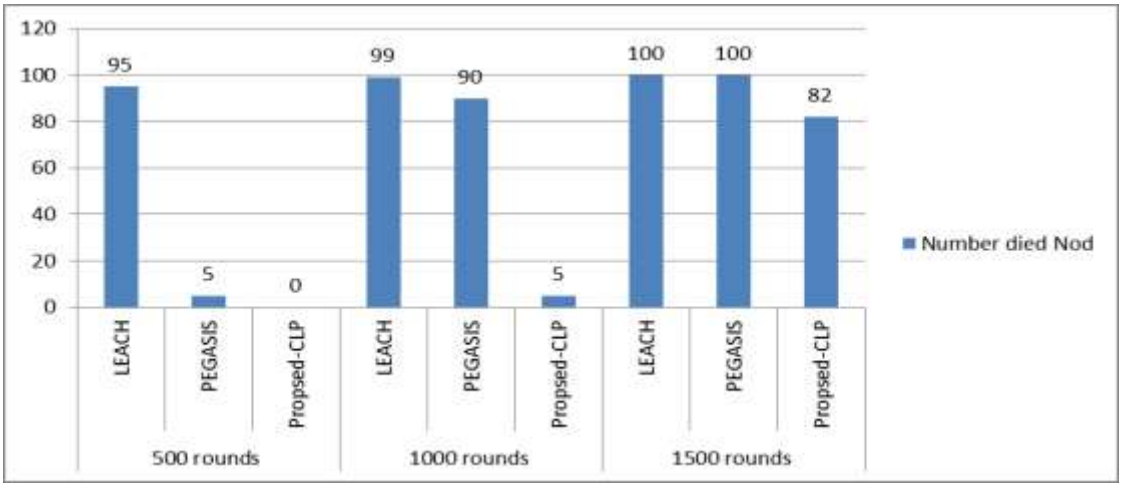

Figure 8. Number died nods in 500, 1000 and 1500 rounds using Basic LEACH, Basic PEGASIS and our CLP Method

As shown in the table 2 and figure 8 above we notice that we have succeeded to minimize the number of died nods in round 500, 1000 and 1500 using our CLP Method:

- After 500 rounds using our proposed method we see that any nods died to compar with basic LEACH and PEGASIS.
- After 1000 rounds we see that just 5 nods are died using our proposed method, 99 nods died using LEACH protocold and 90 nods died using PEGASIS Protocols.
- After 1500 rounds we see that 82 nods are died using our proposed method, 100 nods died using LEACH and PEGASIS Protocols.

6. Conclusion

In this paper, we have presented the LEACH and PEAGSIS routing protocol and our proposed method based on Hiearchical routin protocols(LEACH and PEGASIS) to select a cluser head and construct the chain betaween all CH using LEACH and PEGASIS protocols. We describe the idea of our protocol in detail, and through the simulation experiment in MATLAB, the better performance of our CLP-Protocol compared with the original LEACH and PEGASIS show the performance of our method, considering the energy factor in both leader selection and chain building, CLP-Protocol reliably further minimized the energy cosumption and prolong the life of WSN.

As perspective this work can be used in different directions in our future works to propose a protocol with better consumption of energy and increase more the lifetime of Wireless Sensor Network and thinking about secure exchange data betwen all nodes and base station(BS).

References

[1] Ouafaa IBRIHICH, Said EL HAJJI, Krit Salah-ddine, "Security protocols adapted to wireless sensor networks", DOCTORAL THESIS, 2017.

[2] Tao Li, Feng Ruan, Zhiyong Fan, Jin Wang and Jeong-Uk Kim ,"An Improved PEGASIS Routing Protocol Based on Neural Network and Ant Colony Algorithm ",International Journal of Future Generation Communication and Networking Vol. 8, No. 6 (2015), pp. 149-160

[3] M. Kabrane, S. Krit, K. Bendaoud, M. Elasikri, H. Oudani, H. El Bousty, K. Karimi and L. Elmaimouni "Smart Cities: Energy Consumption in Wireless Sensor Networks for Road Traffic Modeling Using Simulator SUMO" *International Conference on Engineering &MIS 2017 (ICEMIS2017 submission 50),* 08-10 May, Monastir 2017, Tunisia

[4] Mahnaz Esmaeeli, Seyed Ali Hosseini Ghahroudi , February 2016 . Improving Energy Efficiency using a new Game Theory Algorithm for Wireless Sensor Networks. *International Journal of Computer Applications,* (0975 – 8887) Volume 136 – No.12.

[5] X. Zhang, X. Ding, S. Lu and G. Chen, "Principles for Energy-Efficient Topology Control in Wireless Sensor Networks", WiCom '09. 5th *International Conference on Wireless Communications, Networking and Mobile Computing, IEEE,* (2009) September 24-26.

[6] C. Buratti , A. Conti , D. Dardari and R, Verdone, 2009. An Overview on Wireless Sensor Networks Technology and Evolution. *Sensors* 2009, ISSN 1424-8220, pp 6869-6896.

[7] Hassan Oudani , Salah-Ddine Krit , Lahoucine El Maimouni3 and Jalal Laassiri, (Vol.12 Number 1 (2017)) "energy consumption in wireless sensor network : simulation and compartative study of flat and hierarchical routing protocols", *IADIS International Journal on Computer Science and Information Systems* Vol. 12, No. 1, pp. 109-125

[8] S. Lindsey and C.S. Raghavendra, "Pegasis: Power-efficient Gathering in Sensor Information Systems", Proc. of *IEEE Int'l Conf. on Computer Systems, San Francisco,* USA, (2002).

[9] Ravneet Kaur, Deepika Sharma and Navdeep Kaur, Comparative Analysis Of Leach And Its Descendant Protocols In Wireless Sensor Network, *International Journal of P2P Network Trends and Technology, Vol. 3, Issue 1, 2013, pp. 51-55.*

[10] W. Heinzelman, A. Chandrakasan, H. Balakrishnan, Energy-E_cient Communication Protocol for Wireless Microsensor Networks, *International Conference on Systems Science,* vol. 8, pp. 8020, January 2000.

[11] Monika Raghatate,Dipak W. Wajgi, 2014. An energy saving algorithm to prolong the lifetime of wireless sensor network.*International Journal of Wireless & Mobile Networks (IJWMN)*Vol. 6,October ,No. 5.

[12] I. F. Akyildiz, "Wireless sensor networks: a survey. Computer Networks", (2002). vol. 38, no. 4

[13] S. Vhatkar, M. Atique, "Design Issues, Characteristics and Challenges in Routing Protocols for Wireless Sensor Networks," International Journal of Computer Applications (0975 – 8887) *International Conference and Workshop on Emerging Trends in Technology,* 2013.

[14] Hassan Oudani, Salahddine Krit, Mustapha Kabrane, Kaoutar Bandaoud, Mohamed Elaskri, Khaoula Karimi, Hicham Elbousty, Lahoucine Elmaimouni , (2017,May) " Energy Efficient in Wireless Sensor Networks Using Cluster-Based Approach Routing *", International Journal of Sensors and Sensor Networks* 2017; 5(5-1): 6-12

[15] S. Lindsey, C. Raghavendra, "PEGASIS: Power-Efficient Gathering in Sensor Information Systems", *IEEE Aerospace Conference Proceedings, Vol. 3, 9-16 pp.1125-1130, 2002.*

[16] Y. Yong-chang, G. Wei, "An improved PEGASIS in Wireless Sensor Network", Electronic Journal, (2008).