S_LEACH PROTOCOL FOR INCREASING THE LIFETIME OF WIRELESS SENSOR NETWORK

SK. Najma Sultana[1], N.Mounika[2],K.L.V.Vinodini[3],K.L.Priyanka [4]

M.Sudheer Babu[5],K.Varshini[6]

[1]Assistant Professor ,Dept of ECE, PBR VITS ,Kavali, Andhra Pradesh-524201

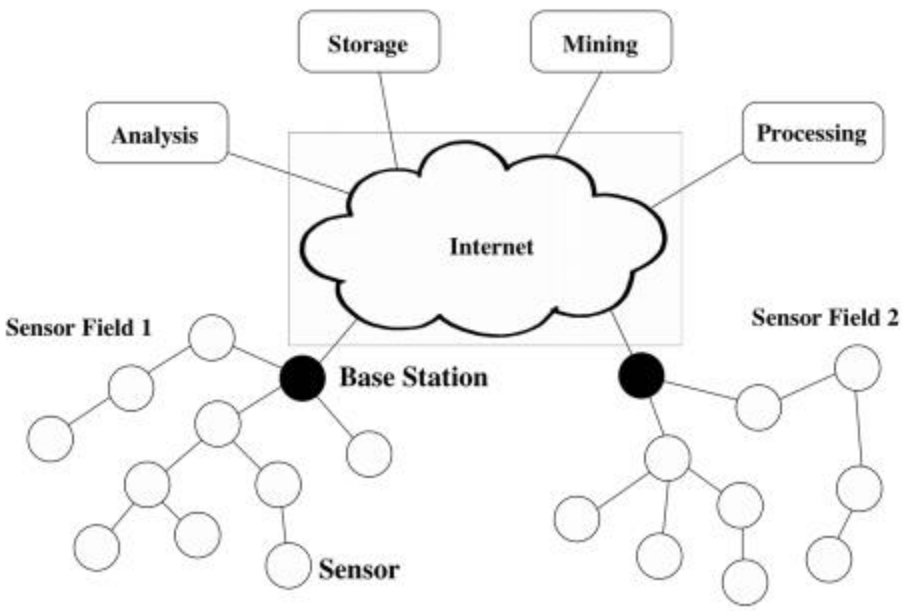
[2,3,4,5,6]UG students ,Dept of ECE,PBR VITS,Kavali,Andhra Pradesh-524201 India.

Abstract - WSNs have been one of the most widely used methods in a variety of uses, including agriculture, factory inspection, health care, and fire detection. WSN is a television network that broadcasts with many benefits, including low cost, compact scale, and ease of use, multifunctional, self-organizing, and capable of WSN routing standard operating procedures .On the other hand, it has several drawbacks, such as those with a reduced battery life or a short lifespan, Sensor deployment area and sensor energy consumption .In this paper, we suggest a new strategy for achieving improved results in terms of network lifetime and data.

Index Terms - WSN, LEACH Protocol, Secondary Cluster Head, Network Lifetime, Energy Efficient.

I. INTRODUCTION:

Wireless Sensor Network (WSN) consists of a large number of very small sensors deployed in a specific area depending on the desired application. Each sensor contains sensing, data processing, and communication components. These sensors form WSN nodes that transfer the sensing data to the Base Station (BS) or sink. In the BS, the data is processed and computed to give understandable results. The communication between BS and wireless nodes is arranged by different protocols. One of the energy-efficient protocols is the S-LEACH routing protocol. . In this protocol, the network is divided into different clusters and we choose to select the closest node to the BS as CH and the closest node to the CH as SCH, with considering on energy and distance parameters of the node. Depending on this suggestion, if the CH dead the cluster will not cut off the communication with the sink and the secondary cluster head replace the dead cluster head and pronounces itself as a cluster head. Rather than that, the cluster continuously connecting the sink as long as the active node alive in the cluster.



II. Literature survey:

[1] Akyildiz, Ian F., et al.: Wireless Sensor Networks (WSNs) are spatially dispersed networks furnished with a large number of nodes for monitoring and recording various environmental conditions like humidity, temperature, pressure, lightening conditions etc. Since WSNs are restrained in terms of their processing power, storage resources, battery life they are not themselves proficient to perform such diverse task set like localization of nodes, data processing etc. Cloud computing (CC) offers on demand access of the resources like networks, storage, servers and applications. The assimilation of WSN and cloud can provide an open, flexible and reconfigurable platform for various monitoring and controlling applications. In this paper, we try to find out how the integration of WSN and cloud computing can help us to achieve various objectives like. Further we have presented an extensive study of the current WSN-CC integration along with their key issues and the methodology recommended by different authors in detail. The research challenges, existing solutions and approaches as well as the future directions are also discussed in this paper.

Summary: Studied about assimilation of WSN and cloud , In addition, studied an analysis of the latest WSN-CC integration, as well as their core problems and the methods suggested by various scholars and discussed the research issues, current ideas and methods, as well as future paths.

[2] M. Quwaider and S. Biswas: This paper presents an experimental modelling framework for energy harvesting sensors in Body Sensor Networks (BSN). Most of BSN applications assume that the sensor nodes have infinite and continuous source of energy. But in reality, this may not be true, especially for the implanted sensors. Instead, the energy for the implanted BSN sensors is likely to come from harvested energy sources such as piezoelectric, magnetic, and thermo- electric generators. In this paper we will explore on-body sensors energy harvesting model using acceleration which is getting a lot of attention in the research community. Recharging batteries with harvested energy could not only extend battery life, but may also dissolve the conventional meaning of network life time. While the energy-harvesting sources can vary widely, we will focus primarily on harvesting using vibration of piezoelectric sensors. Since the piezoelectric energy harvesting depends on movements, the amount of energy harvested at a specific on-body sensor node will depend on the movement pattern of the body part that the node is attached to. As a result, the specific energy generation profile at the BSN nodes does depend on the postural body movement patterns over time.

Summary: Studied about A piezoelectric generator model has been developed that harvests mechanical vibration energy available on the wearable sensor. The proposed model's performance was tested in a lab setting. It was shown that the amount of harvested energy depends on the posture or the level of physical activity of the body movement and the sensor placement, which should be considered in packet routing.

[3] Hein zelman, Wendi Rabiner, Anantha Chandrakasan, and Hari Balakrishnan:

Wireless distributed micro sensor systems will enable the reliable monitoring of a variety of environments for both civil and military applications. In this paper, we look at communication protocols, which can have significant impact on the overall energy dissipation of these networks. Based on our findings that the conventional protocols of direct transmission, minimum-transmission-energy, multi-hop routing, and static clustering may not be optimal for sensor networks, we propose LEACH (Low-Energy Adaptive Clustering Hierarchy), a clustering-based protocol that utilizes randomized rotation of local cluster based station (cluster-heads) to evenly distribute the energy load among the sensors in the network. LEACH uses localized coordination to enable scalability and robustness for dynamic networks, and incorporates data fusion into the routing protocol to reduce the amount of information that must be transmitted to the base station. Simulations show the LEACH can achieve as much as a factor of 8 reduction in energy dissipation compared with conventional outing protocols. In addition, LEACH is able to distribute energy dissipation evenly throughout the sensors, doubling the useful system lifetime for the networks we simulated.

Summary: Studied about LEACH outperforms static clustering algorithms by requiring nodes to volunteer to be high-energy cluster-heads and adapting the corresponding clusters based on the nodes that choose to be cluster-heads at a given time. At different times, each node has the burden of acquiring data from the nodes in the cluster, fusing the data to obtain an aggregate signal, and transmitting this aggregate signal to the base station.

[4] M. Quwaider and S. Biswas,: This paper presents novel store-and-forward packet routing algorithms for Wireless Body Area Networks (*WBAN*) with frequent postural partitioning. A prototype *WBAN* has been constructed for experimentally characterizing on-mobility. On-body DTN routing protocols are then developed using a stochastic link cost formulation, capturing multi-scale topological localities in human postural movements. Performance of the proposed protocols are evaluated experimentally and via simulation, and are compared with a number of existing single-copy DTN routing protocols and an on-body packet flooding mechanism that serves as a performance benchmark with delay lower-bound. It is shown that via multi-scale modeling of the spatio-temporal locality of on-body link disconnection patterns, the proposed algorithms can provide better routing performance compared to a number of existing probabilistic, opportunistic, and utility-based DTN routing protocols in the literature.

Summary: Studied about Store-and-forward packet routing protocols for Wireless Body Area Networks (WBAN) have been developed in this paper. The concept of a stochastic link cost was introduced for enabling a probabilistic and a distance vector on body routing protocol in the presence of postural mobility of human body.

[5] Mhatre, Vivek, and Catherine Rosenberg: A cost based comparative study of homogeneous and heterogeneous clustered sensor networks. We focus on the case where the base station is remotely located and the sensor nodes are not mobile. Since we are concerned with the overall network dimensioning problem, we take into account the manufacturing cost of the hardware as well as the battery energy of the nodes. A homogeneous sensor network consists of identical nodes, while a heterogeneous sensor network consists of two or more types of nodes (organized into hierarchical clusters). We first consider single hop clustered sensor networks (nodes use single hopping to reach the cluster heads). We use LEACH as the representative single hop homogeneous network, and a sensor network with two types of nodes as a representative single hop heterogeneous network. For multi-hop homogeneous networks (nodes use multi-hopping to reach the cluster head), we propose and analyze a multi-hop variant of LEACH that we call M-LEACH. We show that M-LEACH has better energy efficiency than LEACH in many cases. We then compare the cost of multi-hop clustered sensor networks with M-LEACH as the representative homogeneous network, and a sensor network with two types of nodes (that use in-cluster multi-hopping) as the representative heterogeneous network.

Summary: Studied about a cost based comparative analysis of single hop homogeneous and single hop heterogeneous networks. We took into account the hardware as well as the battery cost of the nodes in our analysis.

III. EXISTING SYSTEM:

LEACH protocol or low-energy adaptive clustering hierarchy protocol suggested for wireless sensor networks by MIT's Chandrakasan . LEACH is a self-adaptive cluster formation protocol. The nodes are randomly deployed then one node is selected to be a cluster head which will play a role as a gateway for all nodes in the cluster to the BS. All nodes in the cluster have the same probability to be a cluster head based on the below equation. The cluster head election occurs in the setup phase of each round in the LEACH protocol. Each node generates a random number between 0 and 1, when the generated number is less than the threshold T(n), then the node would be selected as a cluster head. After that, the cluster head node informs all nodes in the same radio range (each node join the CH based on Received Signal Strength Indicator RSSI) that it's the cluster head for the current round and the cluster form. The threshold is defined

$$T(n) = \begin{cases} \frac{p}{1 - p * \left(r \bmod \left(\left(1/p\right)\right)\right)}, & n \in G, \\ 0, & n \notin G, \end{cases}$$

in the following equation where p is the probability of a node to be a cluster head, r is the number of rounds, G is the set nodes that have not been selected in the last 1/p rounds. As the cluster head is known for each node in the cluster and the cluster head form the TDMA slots for each node in its cluster (to prevent interference). Then the steady-state stage of the LEACH protocol process starts. Next, all nodes send the data packet to the cluster head then the cluster head integrates the data packets and sends the fused data to the BS. We have noticed that the cluster head missions are more than the ordinary nodes, so the cluster head consumes more energy than the others which one of the drawbacks of the LEACH algorithm. LEACH disregards the BS and cluster head geographical positions, energy consumption, a nd instability in the case of cluster head death.

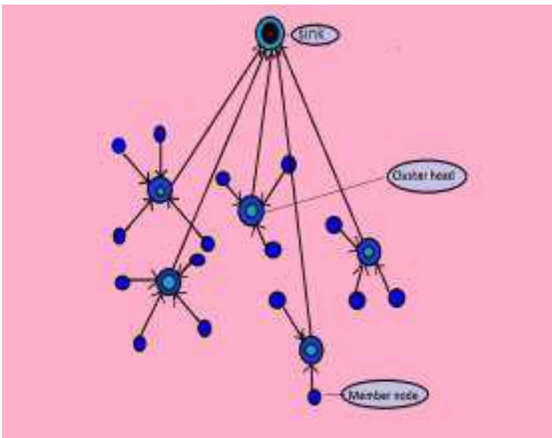


Figure : Hierarchical or cluster based routing

IV. PROPOSED ALGORITHM:

On breaking down the properties of LEACH protocol, cluster head selection plays the main role in enhancing and improving the network lifetime, data transmission and energy-efficient. We propose a new algorithm to improve the lifetime of the network by selecting Cluster Head (CH) and Secondary Cluster Head (SCH) in the sensor setup phase of each round. According to previous researches, the nearest the distance between CH and BS, the better lifetime and energy-efficient the network is. Basis equation (1) we choose to select the closest node to the BS as CH and the closest node to the CH as SCH, with considering on energy and distance parameters of the node. Depending on this suggestion, if the CH dead the cluster will not cut off the communication with the sink and the secondary cluster head replace the dead cluster head and pronounces itself as a cluster head. Rather than that, the cluster continuously connecting the sink as long as the active node alive in the cluster. The threshold in the proposed method is defined as follows:

$$T(n_i) = \begin{cases} \frac{p}{1-p*(r \bmod (\frac{1}{p}))} + \left(\sqrt{2} - \frac{dis(Si)}{\left(\frac{(x+y)}{e}\right)}\right) / \alpha \\ 0 \end{cases}$$

The threshold is defined above because we want node energy criteria and node-sink distance to be effective in determining CH and SCH. Although Select secondary cluster head costs more time in the setup phase for the same round, it keeps the cluster communicate with the BS in case it has alive nodes. Equation 4 what we call the distance coefficient

$$\sqrt{2} - \frac{dis(si)}{\left(\frac{(x+y)}{e}\right)}) / \alpha$$

increases the likelihood of nodes being shorter than the sink. dis(si) compute the distance of the node i to the sink. This value can be calculated by relying on the Euclidean distance (the distance between two nodes is the line length between them) and as shown in below equation

$$d(p,q)=\sqrt{q_1 \ - p_1 \ )\hat{}2 \ + \ (q_2 \ - p_2 \ )\hat{}2}$$

Where, points p = (p1, p2) and q = (q1, q2) are the locations of the two nodes. The number of CH should equal the number of SCH (one SCH for each CH) at the beginning of the round. Returning to reducing data transmission time, we suggest that the position of BS should be in the center of the WSN as shown in Figure surrounding with four equal-area squares in order to optimize energy consumption for communicating between clusters and BS.

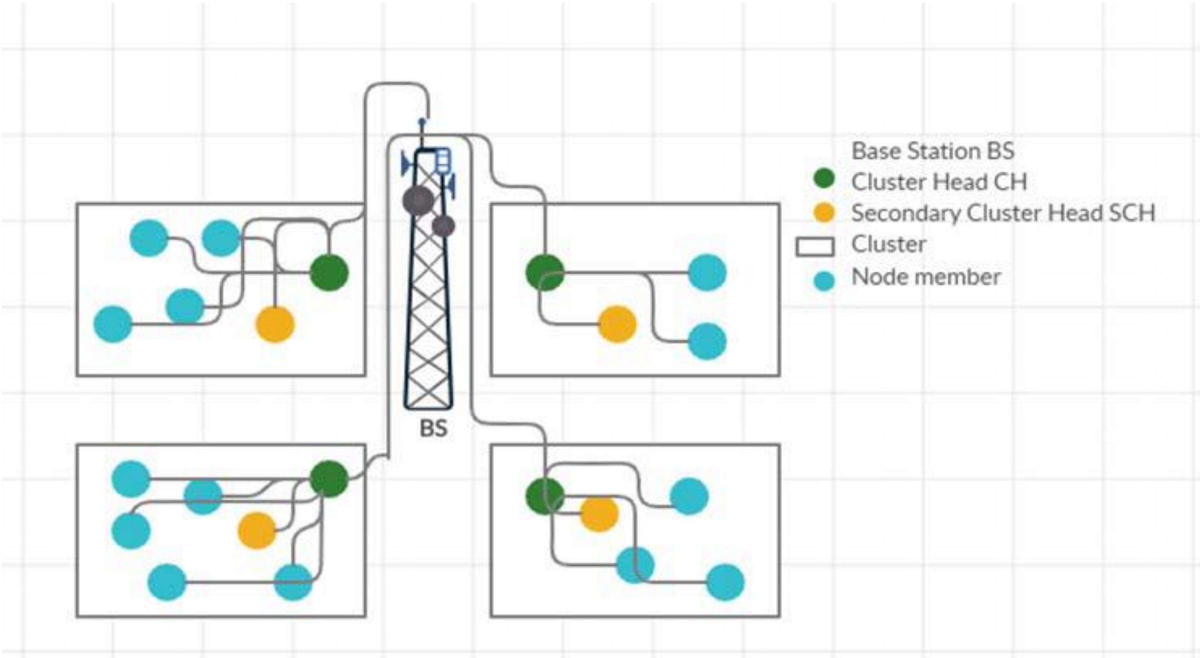


Figure : Architecture platform of the proposed algorithm

From the perspective of making the network with high latency. we applythe algorithm of node density in the cluster. Some nodes are not able to join the cluster because they have not the range ratio of any cluster, So they connect to BS directly without electing CH by the protocol which called Direct transmission (DTx).

Considering the major issues of the Wireless Sensor Networks, We focus on the most common algorithm. LEACH protocol, which enhanced the performance of the WSN such as Energy efficient, Transmission time, transmission rate, optimal position of the sink, the optimal position of the cluster head, node density and network lifetime. These are the main performance enhancement factors that we figure out in this paper. Figure 4 shows the initial LEACH protocol with homogenous network topology using MATLAB (Version:9.2.0,518641) with an area of 100 × 100m. BS is in the center of the network (50,50), with 100 nodes are deployed randomly and certain nodes are randomly selected as cluster heads. We fixed a maximum number of clusters to be 10, a maximum number of rounds is 5000 and the initial energy equal 0.5Joules. Then, we set the data packet size equal to 4000 bits and the number of packets from each node to be 10 each round. We prefer to save the same parameters for all algorithms to gain fair comparison

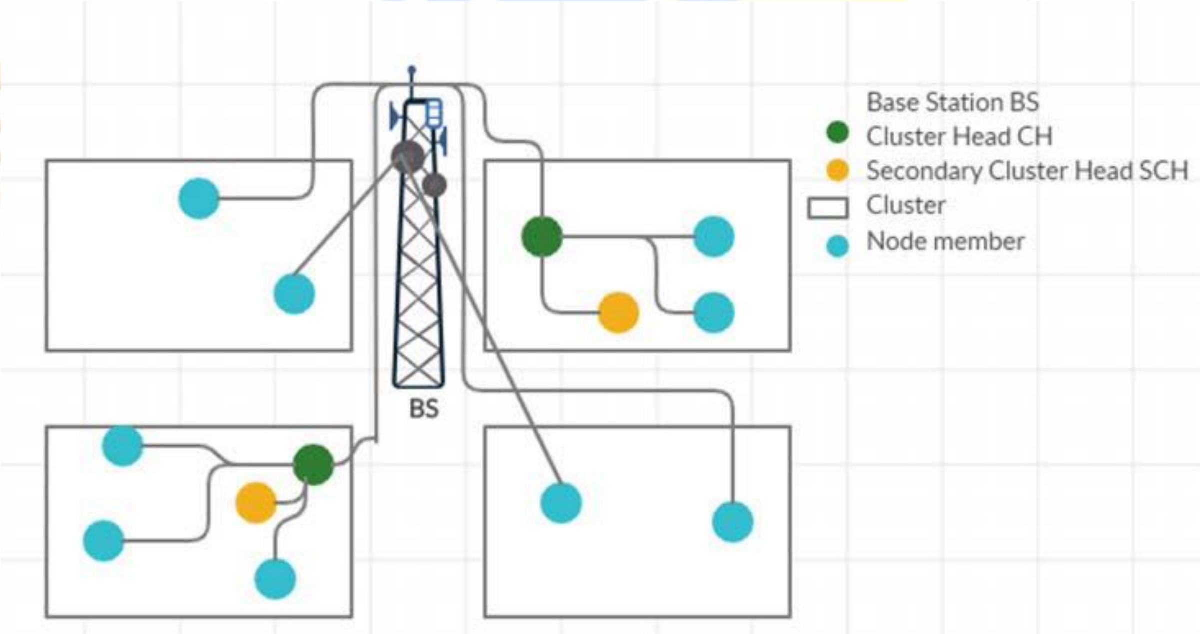


Figure : Nodes density in a cluster; LEACH protocol connection and DTx protocol connection with BS

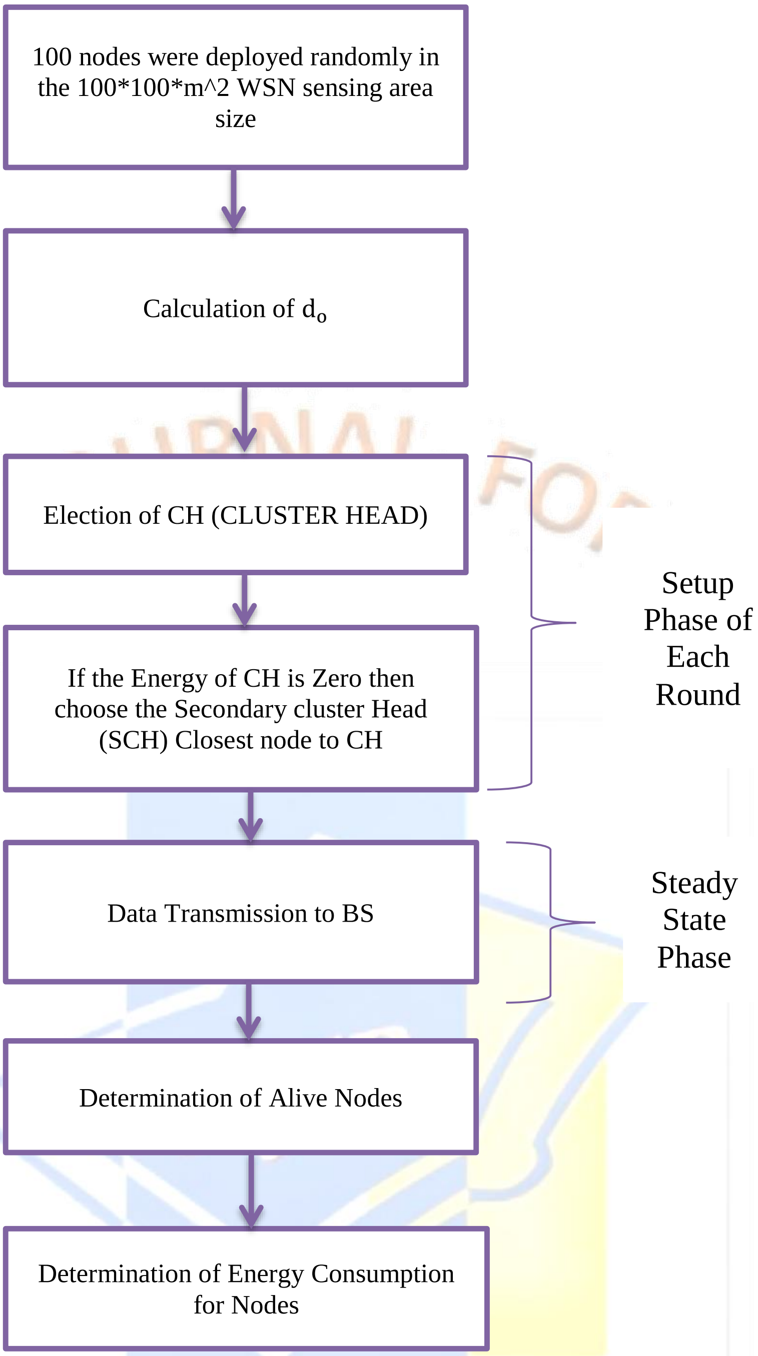


Fig : Block diagram of proposed system

Advantages:

1.If the CH is dead ,the secondary cluster head replace the dead cluster head and pronounces itself as a cluster head.

2.In S-LEACH, the lifetime of the network is improved by selecting Cluster Head (CH) and Secondary Cluster Head (SCH) in the sensor setup phase of each round.

3. Secondary Cluster Head (SCH) is selected nearer to Cluster Head so there is no more energy consumption problem.

4. Some nodes are not able to join the cluster because they have not the range ratio of any cluster, So they connect to BS directly without electing CH by the protocol which called Direct transmission (DTx).

Applications:

1.Industrial control

2.Environmental monitoring

3. Military surveillance

4.Intelligent transportation systems and medical field

5.Biodiversity mapping

6.Monitoring of temperature, pressure, and humidity.

V. RESULTS AND DISCUSSION:

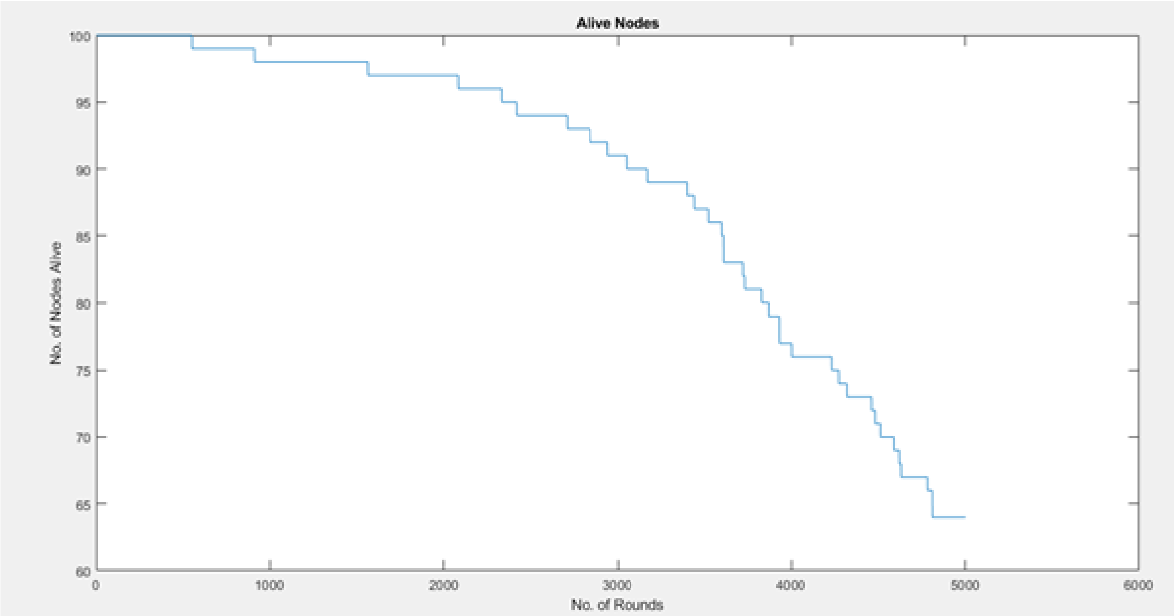


Figure : Number of live nodes

Network lifetime measurement factor is used to monitor the network life cycle, in this paper we focus on the last dead node in the whole network concurrently with data packet transmission through the network. As shown in the figure, by using our proposed algorithm, the last dead node was in round 4812 .The reflection also appears on energy consumption. The network lifetime is increased due to the efficient way of energy consumption by transmitting the data packet in our proposed algorithm. Figure shows the energy consumption of the proposed algorithm. As shown in the figure for example, the average consumed energy in round 1000 was 0.13J .

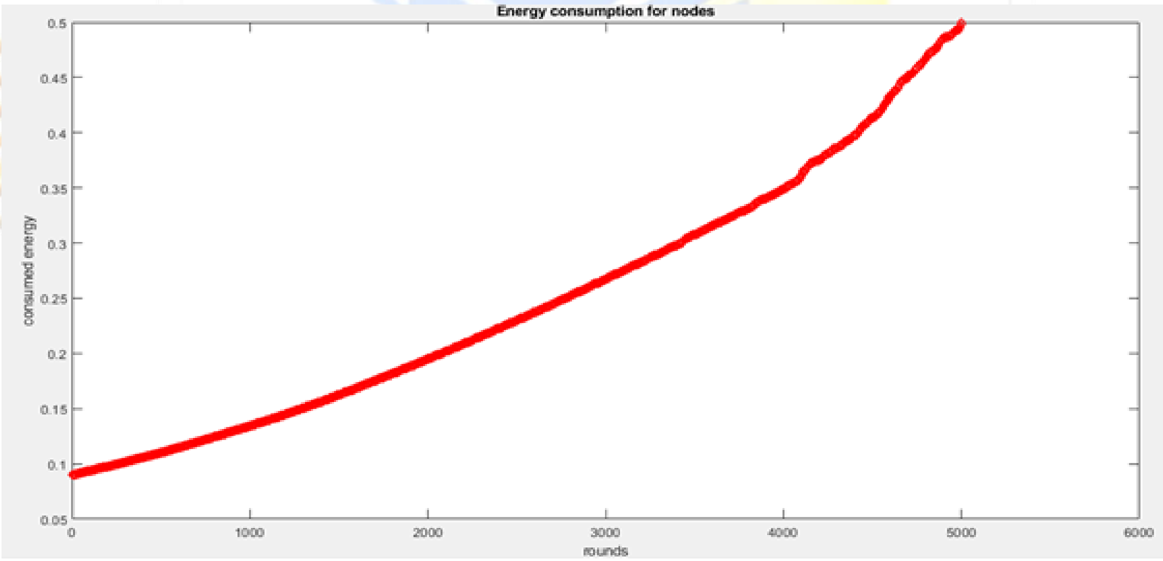


Figure : Energy consumption for effective network

VI. CONCLUSIONS:

The wireless sensor networks are widely used in different areas. In this paper, we proposed a new algorithm called Secondary Cluster Head (SCH), which becomes a cluster head simultaneously with the death of the previous CH. Therefore, all WSN cluster keep transmitting data even if some nodes dead, which increase the network lifetime and the network performance. It is shown that the last dead node in the proposed algorithm was in round 4425, which increased the network lifetime by 128.80% compared with the basic LEACH protocol. Also, that increased the number of transmitted data packet in the network with the same network settings compared with the basic LEACH protocol. As future work, it would be worth to apply the proposed S-LEACH algorithm in different WSN routing protocols to minimize network traffic and the best path for data to travel from cluster to sink.

VII. REFERENCES

[1] Akyildiz, Ian F., et al. "A survey on sensor networks." IEEE Communications magazine 40.8 (2002): 102-114.

[2] M. Quwaider and S. Biswas, “Modeling energy harvesting sensors using accelerometer in body sensor networks,” in Proceedings of the 8th International Conference on Body Area Networks, 2013, pp. 148–152, Accessed: Nov. 27, 2014. [Online]. Available: http://dl.acm.org/citation.cfm?id=2555348.

[3] Heinzelman, Wendi Rabiner, Anantha Chandrakasan, and Hari Balakrishnan. "Energy-efficient communication protocol for wireless microsensor networks." Proceedings of the 33rd annual Hawaii international conference on system sciences. IEEE, 2000.

[4] M. Quwaider and S. Biswas, “DTN routing in body sensor networks with dynamic postural partitioning,” Ad Hoc Netw., vol. 8, no. 8, pp. 824–841, 2010.

[5] Mhatre, Vivek, and Catherine Rosenberg. "Homogeneous vs heterogeneous clustered sensor networks: a comparative study." 2004 IEEE international conference on communications (IEEE Cat. No. 04CH37577). Vol. 6. IEEE, 2004.

[6] M. Quwaider, “Real-time intruder surveillance using low-cost remote wireless sensors,” in 2017 8th International Conference on Information and Communication Systems (ICICS), 2017, pp. 194–199.

[7] Sharma, Nishi, and Vandna Verma. "Energy efficient LEACH protocol for wireless sensor network." International Journal of Information and Network Security 2.4 (2013): 333.

[8] Naveen, Sharma , and Anand Nayyar. "A comprehensive review of cluster based energy efficient routing protocols for wireless sensor networks." International Journal of Application or Innovation in Engineering & Management (IJAIEM) 3.1 (2014): 441-453.

[9] Prasad, A. Y., and R. Balakrishna. "Implementation of optimal solution for network lifetime and energy consumption metrics using improved energy efficient LEACH protocol in MANET." Telkomnika 17.4 (2019): 1758-1766.

[10] Nandi, Arnab, et al. "Centered Sink LEACH Protocol for Enhanced Performance of Wireless Sensor Network." 2019 International Conference on Automation, Computational and Technology Management (ICACTM). IEEE, 2019.