Lifetime Enhancement of Hierarchical Routing Technique of Wireless Sensor Networks using Improved LEACH

Avneet Kaur Dhaliwal[*]	**Nitika Phull**	**Barinder P. Singh**
Research Scholar, CSE Department	Assistant Professor, CSE Department	Assistant Professor, ECE Department
RIEIT, Ropar, India	RIEIT, Ropar, India	F.C.E.T., Ferozeshah, India

Abstract— Wireless Sensor Networks are networks consisting of many small devices or nodes. The nodes are combined with a small battery which becomes complicated to swap or restore. The lifetime of battery plays an important role for whole process of sensing of data, gathering of data and transmission of gathered data. For this reason, the battery life of Sensor Networks in wireless manner should be as strong as possible so as to sense the data from the environment around it or from an environment where the nodes are deployed. The concept of hierarchical routing is implemented in this paper using Improved Low Energy Adaptive Clustering Hierarchy Protocol which works on the formation of Cluster Head with in a Cluster. The Cluster Head within each and every cluster has to send the data to the cluster head of another cluster in a proficient manner. The whole of the work is done using MATLAB simulator. The results have been taken out showing the comparison between Low Energy Adaptive Clustering Hierarchy Protocol and Improved Low Energy Adaptive Clustering Hierarchy Protocol.

Keywords— Wireless Sensor Networks (WSN), Low Energy Adaptive Clustering Hierarchy Protocol (LEACH), Improved Low Energy Adaptive Clustering Hierarchy Protocol (I-LEACH), Cluster Head (CH).

I. INTRODUCTION

The Wireless Sensor Networks (WSNs) in general, poised of massive extent of sensor nodes organized profusely over a definite appreciable region. The nodes or sensors necessitate minuscule power for their action and low-cost in nature also. These nodes or devices are abounding with entrenched micro-controllers, radio receivers and energy systems for the development of sensing and processing of information. The devices or nodes sense the information from the environment nearby them. The sensed data is then gathered by the node on intermediate side. The intermediate node then transmits the gathered data to the Base Station (BS) which is also called Main Node or Central Node This main node then makes contact with the client or user or also called end user. The end user is then contacted by the Base Station. The process of conveyance of information or data is done by using the technique named Routing. Routing mechanism plays a crucial role for the transmission of information because the path is provided by the routing [1]. The transmission becomes proficient if the routing is competent and becomes ineffectual by the exploitation of disorganized routing. Apart from the concept of routing, the passage of information also depends largely on the nature of protocol used. Various routing protocols are used in last decade which show an imperative role in enhancing the lifetime of network by providing the path which is efficient in nature [2]. The basic architecture of WSN is shown in the figure1.
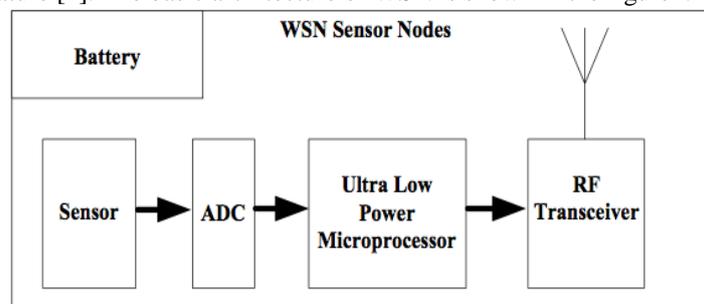

Fig. 1 Wireless Sensor Networks and Nodes

Figure 1 shows the fundamental architecture of Wireless Sensor Network which demonstrates the integration of a collection of components used for the development of WSN. The clarification of the components used for the formation of WSN is enlightened in the points below:

In Sensor Networks, Nodes measure the ambient conditions in the environment surrounding them. These measurements then transform into signals that can be processed to reveal some characteristics about the event. The gathered data is then route to a special node, called sink node (also called Base Station). After that, the sink node transmits data to the user via

Internet or satellite, through a gateway. Combining the advantages of wireless communication with some computational capabilities, WSNs have an everlasting collection of potential applications in both military and civilian applications including robotic land-mine detection, target tracking, battlefield surveillance, environmental monitoring, catastrophe monitoring, wildfire detection, structural monitoring, industry, security, agriculture, traffic monitoring, home for monitoring natural phenomena etc.

Main goal of the process is to examine a region to collect and pass on information to a sink node or set of sink nodes which is called as Base Station (BS) [1,3]. Forwarding the data to the BS is possible in two ways:

    1) Direct Hop Communication

    2) Multi hop Communication

In Time-driven network, every node sends messages at regular intervals, while in an Event-driven a node transmits message only when sensing a phenomenon [9]. The third category is the Query-driven network approach in which the sensors send data only after receiving a enquiry from the BS. There are also hybrid networks that unite the previous three models.

    a) Time-Driven Network

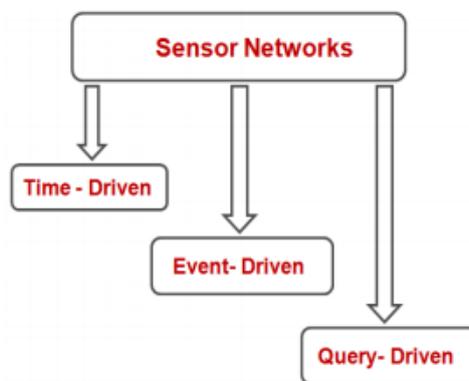   b) Event-Driven Network

    c) Query-Driven Network.

Fig. 2 Periodicity of Data Transmission

II. LEACH PROTOCOL

Low Energy Adaptive Clustering Hierarchy (LEACH) is a hierarchical routing's an efficient routing protocol whose mechanism is based on the formation of CHs within a cluster. The CHs then make contact with each other for the transmission of data from one node to another until the data reaches to the ultimate node i.e. BS. LEACH was proposed in the year 2000 by Heinzelman [2] which is also known as Hierarchical Clustering algorithm for sensor networks [3]. The concept of distributed cluster formation in the implementation of LEACH protocol gives the about regarding its cluster-based nature. The working of LEACH protocol is based on the concept of hierarchical routing scheme in which the formation of two layered structure take place. The one layer is used for the selection of the CH while the second layer is used to route the data from one node to another [9]. LEACH protocol works on two phases which are named as setup phase and steady state phase. The work of setup phase is to select the CHs after the proper association of clusters. On the other hand, the transference of data from one node to another node takes place in the second phase named as steady state phase. To reduce the effect of overhead, the duration of second phase i.e. steady state phase is kept longer than that of setup phase [4]. The working of LEACH protocol in terms of transmitting and receiving of data is based on the allocation of diverse set of Code Division Multiple Access (CDMA) codes which helps in the secure interlink among the nodes.

The data received by the CH from the node has to be compressed first before the transmission of data to the BS. This prevents the congestion within the network which helps in increasing the efficiency of the network [8]. The nodes in LEACH protocol are homogeneous in nature which means that all the nodes are equipped with same amount of energy levels and are capable to perform the same tasks of sensing, gathering or compressing and transmitting the data. This is one of the biggest disadvantages in LEACH protocol where the energy level of BS is same as that of other nodes deployed. This also reduces the efficiency of LEACH protocol because the communication at larger distances gets affected by the same energy level of BS as that of other nodes [9]. The equation used for the working of LEACH is shown beneath [10][11][12].

$$T(n) = \frac{p}{1 - p(r \bmod (\frac{1}{p}))} \quad if \ n \in G$$

III. PROPOSED METHODOLOGY

In this paper, the concept of hierarchical routing is used along with Improved LEACH and LEACH protocol. Whole of the work is done on MATLAB Simulator where the 100 nodes are deployed.
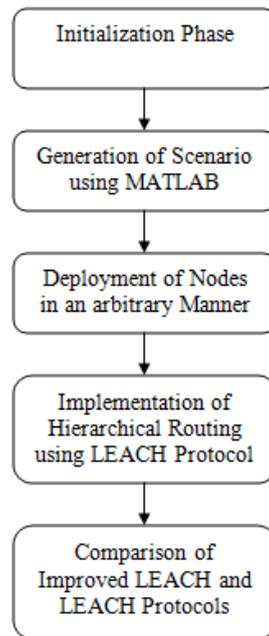
Fig. 3 Flowchart

The initialization is done in step one. In the second step, the generation of environment takes place by using MATLAB Simulator and the deployment of nodes occurs in the step third in an arbitrary or random manner. The implementation of hierarchical routing is done in the step fourth where the LEACH protocol is used in order to perform the hierarchical routing mechanism.

The step fifth is the last and final step where the comparative analyzation is taken out in between Improved and traditional LEACH protocol.

IV. SIMULATIONS RESULTS AND DISCUSSION

In this section, the simulated results and discussion has been taken out by using Improved LEACH protocol and MATLAB Simulator. The basic result is to enhance the lifetime of sensor nodes by the implementation of Improved LEACH protocol which is an efficient variant of traditional LEACH protocol.
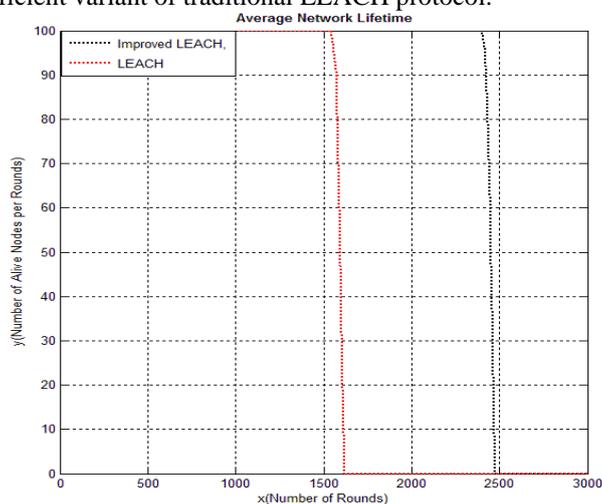

Fig. 4 Number of Rounds using Improved LEACH and LEACH Protocol

Figure 4 showing the analyzation of number of rounds by nodes between Improved and traditional LEACH protocols. The results show that the traditional LEACH protocol is covering lesser rounds as compared to Improved LEACH protocol. Hence, the Cluster Head formation is much more efficient in Improved LEACH protocol than that of traditional LEACH protocol.

V. CONCLUSION

In this section, we can conclude that the energy efficiency is one of an imperative issue which occurs mainly in Wireless Sensor Networks. To enhance the lifetime of network, Improved LEACH transfers the data or information from source node to destination node or BS by the formation of hierarchical networks along with CH within a cluster. The results showing that the Improved LEACH protocol is more proficient because of the formation of effective CHs and hence enhancing the number of rounds by the nodes.

REFERENCES

[1] I. F. Akyildiz, W. Su, Y. Sankarabramaniam and E. Cayirci, "A Survey on Sensor Networks", IEEE Communications Magazine, vol. 40, pp. 102--114, 2002.

[2] W.R. Heinzelman, A. Chandrakasan and H. Balakrishnan, "Energy-Efficient Communication Protocol for Wireless Microsensor Networks", in proceedings of Hawaii international conference on system sciences, IEEE, pp. 1-10, 2000.

[3] E. H. Callawa , "Wireless Sensor Networks: Architectures and Protocols", Boca Raton, FL: Auerbach Publications, 2003.

[4] K. Sohrabi and J. Pottie, "Protocols for self-organization of a wireless sensor network", IEEE Personal Communications, vol. 7, no. 5, pp. 16--27, 2000.

[5] J. N. Al-Karaki and A. E. Kamal, "Routing Techniques in Wireless Sensor Networks: A Survey", ICUBE initiative of Iowa State University, Ames, IA 50011, pp. 1—36, 2004

[6] B.P. Singh, A. Arora and A. Kumar, "Security in Wireless Sensor Network", Journal of Advances in Physics, vol.1, no. 3, pp. 1--4, 2010.

[7] S.K. Singh, M.P. Singh, and D.K. Singh, "Routing Protocols in Wireless Sensor Networks - A Survey", International Journal of Soft Computing and Engineering (IJSCE), vol. 72, no. 8, pp. 35--39, 2011.

[8] V. Popli and B.P. Singh, "Fuzzy Sets and Artificial Intelligence: A Survey", International Journal of Advanced Research in Computer Science and Software Engineering, vol. 4, no. 10, pp. 308-313, 2014.

[9] H. Deepa and A.K. Das, "A Study on Routing Protocols in Wireless Sensor Network", International Journal of Computer Applications, vol. 72, no. 8, pp. 35--39, 2013.

[10] V. Geetha, P.V. kallapur, and S. Tellajeera, "Clustering in Wireless Sensor Networks: Performance Comparison of LEACH & LEACH-C Protocols Using NS2", 2nd International Conference on Computer, Communication, Control and Information Technology (C3IT-2012) ELSEVIER, vol. 4, pp. 163-170, 2012