An Extensive Literature Review of MODLEACH for Wireless Sensor Network

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Abstract-Sensor network consists of tiny sensors and actuators with general purpose computing elements to cooperatively monitor physical or environmental conditions, such as temperature, pressure, etc. Wireless Sensor Networks are uniquely characterized by properties like limited power the y can harvest or store, dynamic network top ology, large scale of deployment. Sensor networks have a huge application in fields which includes habitat monitoring, object tracking, fire detection, land slide detection and traffic monitoring. Based on the network top ology, routing proto cols in sensor networks can be classified as flat-based routing, hierarchical-based routing and location-based routing. Low Energy Adaptive Clustering Hierarchy (LEACH) is an energy-efficient hierarchical- based routing protocol.

Keywords: - Clustering, energy efficiency, LEACH, lifetime, stability period, WSN

I. INTRODUCTION

Like living organisms, a variety of modern devices and equipment's relies on the sensory data from the real world around it. These sensory data comes is provided by Wireless Sensor Networks (WSN), which consists of several tiny sensor no des to monitor physical or environmental conditions, such as temperature, vibration, pressure, sound or motion, and then collectively send these information to a central computing system, called the base station or sink. Different routing proto cols govern the movement of this information. Broadly the routing protocols can be classified as flat-based routing, hierarchical-based routing, and location-based routing. LEACH (Low Energy Adaptive Clustering Hierarchy) is a hierarchical-based routing proto col which uses random rotation of the no des required to be the cluster-heads to evenly distribute energy consumption in the network. Sensor network protocols are quite simple and hence are very susceptible to attacks like Sinkhole attack, Selective forwarding, Sybil attack, Wormholes, HELLO flood attack, Acknowledgement spoofing, altering, replaying routing information. For example, Selective forwarding and HELLO flood attack affects networks with clustering based proto cols like LEACH.

Wireless sensor network

Sensor networks refers to a heterogeneous system consisting of multiple detection stations called sensor nodes with a communications infrastructure intended to monitor and record conditions at diverse locations. Sensor no des, also known as mote, are small, lightweight and portable devices equipped with a transducer, microcomputer, transceiver, and power source. The transducer produces electrical signals based on the sensed physical phenomena. The microcomputer processes and stores the sensed information. The transceiver receives instructions from the base station/central computing system and sends data to it. Each sensor no des derives its energy usually from a battery or any other embeddedform of energy harvesting. A structure of a WSN is shown in Figure 1.

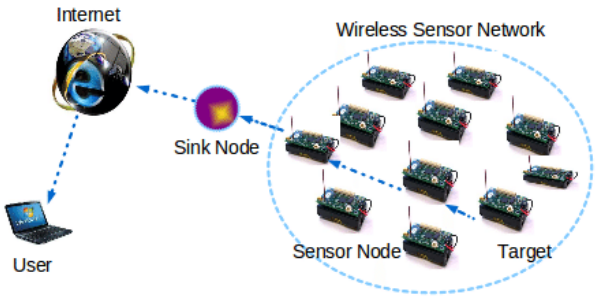

Figure 1: Wireless Sensor Network

The size of the sensor nodes vary from that of a shoebox tothat of a minute s and-particle. Similarly their cost also varies from hundreds of dollars to a few pennies. Size and cost constraints result in corresponding constraints on energy, memory, computational speed and communications bandwidth.

Wireless Sensor Networks are characterized by:

- Limited power they can harvest or store
- Ability to cope with node failures
- Heterogeneity of nodes
- Large scale of deployment
- Mobility of nodes
- Communication failures
- Dynamic network topology
- Ability to withstand harsh environmental conditions

II. APPLICATION OF WIRELESS SENSOR NETWORK

Wireless Sensor Networks (WSN) offers a rich, multi-disciplinary area of research, in which a number of tools and concepts can be applied to address a whole diverse set of applications. Sensor networks may consist of manydeterrent types of sensors such as magnetic, thermal, visual, seismic, and infrared and radar, which are able to monitor a wide variety of conditions. This sensor no des can be put for continuous sensing, location sensing, motion sensing and event detection. The idea of micro-sensing and wireless connection of these sensors no des promises many new application areas. A few examples of their applications are as follows:

Area Monitoring

Area monitoring is a very common application of WSNs. In area monitoring, the WSN is deployed over a region where some physical activity or phenomenon is to be monitored. When the sensors detect the event being monitored (sound, vibration), the event is reported to the base station, which then takes appropriate action (e.g., send a message on the internet or to a satellite). Similarly, wireless sensor networks can be deployed in security systems to detect motion of the unwanted, traffic control s ys tem to detect the presence of high-speed vehicles.

Environmental

A few environmental applications of sensor networks include forest fire detection, greenhouse monitoring, landslide detection, air pollution detection and flood detection. They can also be used for tracking the movement of insects, birds and small animals, planetary exploration, monitoring conditions that affect crops and livestock and facilitating irrigation.

Health

Some of the health applications for sensor networks are providing interfaces for the disabled, integrated patient monitoring, diagnostics, drug administration in hospitals, monitoring the movements and internal pro cesses of insects or other small animals, tele-monitoring of human physiological data; and tracking and monitoring do ctors and patients inside a hospital.

Industrial

WSNs are now widely used in industries, for example in machinery condition-based maintenance. Previously inaccessible locations, rotating machinery, hazardous or restricted areas, and mobile assets can now be reached with wireless sensors. They can also be used to measure and monitor the water levels within all ground wells and monitor leachate accumulation and removal.

LEACH

The main objectives of LEACH, was to find a way to low consumption of energy in the cluster and to improve the life time of WSN.

LEACH adopts a hierarchical and adaptive approach to organize the network intoa set of clusters, managed by selected CHs. The CH carries out multiple tasks, such as periodic collection of data from the members of the cluster, aggregation of data to remove redundancy among correlated values, transmission of the aggregated data directly to the base station through a single hop method, creation and advertisement of a TDMA schedule. In the schedule created by the CH, each node of the cluster is

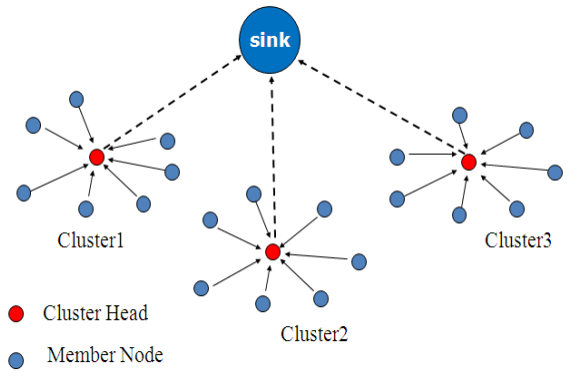

Figure 2. A Network Model of LEACH

assigned a time slot that can be used by non-CH nodes for transmission. The CHs broadcast the schedule to their corresponding cluster members. For reducing the likelihood of collisions among sensor nodes, LEACH nodes use a code division multiple accesses (CDMA) based scheme for communication. The network model used by LEACH is depicted in Figure 2.

III. LITERATURE SURVEY

N. K. Pandya, H. J. Kathiriya, N. H. Kathiriya and A. D. Pandya,[1] Energy efficiency is resent issue in wireless sensor network (WSN). Hierarchical routing or Clustering is best solution for reducing energy consumption in WSN. LEACH (Low energy adaptive clustering hierarchy) is good hierarchical protocol. There are many protocols introduced based on LEACH but still have issue of energy efficiency. Lots of research is going on CH (cluster head) election algorithm, data aggregation, reducing number of transmission and different power levels. MODLEACH (Modified LEACH) uses three transmission power levels which reduces energy consumption in network; also it uses different cluster head election algorithm in which node

have remaining energy greater than threshold it remain as cluster head for next round. Equation used in MODLEACH for electing cluster head was same as used in LEACH. Authors enhance MODLEACH by using different equation for cluster head election as used in HEED (Hybrid Energy-Efficient Distributed clustering) such that it elect node as cluster head based on remaining energy of node. Also authors enhanced MODLEACH by putting energy hole removing mechanism such that if node has energy less than threshold, it puts a node into sleep mode. If number of sleep nodes greater than 10 then putting sleep nodes one by one into active mode. So their approach increased lifetime in terms of first dead node, stability period and packets to base station (BS) or sink.

Table 1: Summary of Literature Review

SR. NO.	TITLE	AUTHORS	YEAR	METHODOLOGY
1	Design and simulation of enhanced MODLEACH for wireless sensor network	N. K. Pandya, H. J. Kathiriya, N. H. Kathiriya and A. D. Pandya	2015	MODLEACH (Modified LEACH) have been proposed for wireless sensor network.
2	Energy-efficient communication protocol for wireless microsensor networks	W. R. Heinzelman, A. Chandrakasan and H. Balakrishnan	2000	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.
3	A survey on energy efficient routing techniques in Wireless Sensor Network	M. A. Rahman, S. Anwar, M. I. Pramanik and M. F. Rahman	2013	Replace or recharge due to the inherent nature and types of applications WSN is used.
4	HEED: a hybrid, energy-efficient, distributed clustering approach for ad hoc sensor networks	O. Younis and S. Fahmy	Oct.-Dec. 2004	Propose a novel distributed clustering approach for long-lived ad hoc sensor networks.
5	E-HORM: An energy-efficient hole removing mechanism in Wireless Sensor Networks	M. B. Rasheed, N. Javaid, Z. A. Khan, U. Qasim and M. Ishfaq	2013	Propose Energy-efficient HOle Removing Mechanism (E-HORM) technique to remove energy holes.

W. R. Heinzelman, A. Chandrakasan and H. Balakrishnan, [2] Wireless distributed microsensor systems will enable the reliable monitoring of a variety of environments for both civil and military applications. In this paper, authors look at communication protocols, which can have significant impact on the overall energy dissipation of these networks. Based on authors findings that the conventional protocols of direct transmission, minimum-transmission-energy, multi-hop routing, and static clustering may not be optimal for sensor networks, authors 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 authors simulated.

M. A. Rahman, S. Anwar, M. I. Pramanik and M. F. Rahman,[3] Energy conservation in Wireless Sensor Network (WSN) has always been the most crucial issue, for the sensor nodes are all powered by limited capacity battery sources which are difficult, if not impossible, to replace or recharge due to the inherent nature and types of applications WSN is used for. Therefore, energy efficient design of WSN has drawn considerable attention from

many researchers resulting in quite a good number of approaches for saving the precious and limited energy of the sensor nodes. However, designing energy efficient routing protocol for WSN is the area that has received the most of the attention giving rise to many Energy Efficient Routing (EER) protocols. In this paper, a comprehensive list of these EER protocols have been studied having classified them into proper categories. The relative advantages and disadvantages of the protocols are also discussed while the protocols are evaluated based on certain performance metrics at the end of the paper.

O. Younis and S. Fahmy,[4] Topology control in a sensor network balances load on sensor nodes and increases network scalability and lifetime. Clustering sensor nodes is an effective topology control approach. Authors propose a novel distributed clustering approach for long-lived ad hoc sensor networks. Authors proposed approach does not make any assumptions about the presence of infrastructure or about node capabilities, other than the availability of multiple power levels in sensor nodes. Authors present a protocol, HEED (Hybrid Energy-Efficient Distributed clustering), that periodically selects cluster heads according to a hybrid of the node residual energy and a secondary parameter, such as node proximity to its neighbors or node degree. HEED terminates in O(1) iterations, incurs low message overhead, and achieves fairly uniform cluster head distribution across the network. Authors prove that, with appropriate bounds on node density and intracluster and intercluster transmission ranges, HEED can asymptotically almost surely guarantee connectivity of clustered networks. Simulation results demonstrate that authors proposed approach is effective in prolonging the network lifetime and supporting scalable data aggregation.

M. B. Rasheed, N. Javaid, Z. A. Khan, U. Qasim and M. Ishfaq, [5] Cluster based routing protocols for Wireless Sensor Networks (WSNs) have been widely used for better performance in terms of energy efficiency. Efficient use of energy is challenging task of designing these protocols. Energy holes are created due to quickly drain the energy of a few nodes due to no uniform node distribution in the network. Normally, energy holes make the data routing failure when nodes transmit data back to the sink. Authors propose Energy-efficient HOle Removing Mechanism (E-HORM) technique to remove energy holes. In this technique, authors use sleep and awake mechanism for sensor nodes to save energy. This approach finds the maximum distance nodes to calculate the maximum energy for data transmission. Authors consider it as a threshold energy Eth. Every node first checks its energy level for data transmission. If the energy level of node is less than E_{th}, it cannot transmit data.

IV. PROBLEM IDENTIFICATION

Clustering reduces energy consumption in Wireless Sensor Network. LEACH was first clustering protocol. There are several protocols based on LEACH introduces with their advantages and disadvantages in this report. Proposed protocol for homogeneous and also for proactive network as well as reactive are explained. Different cluster head election equation and algorithm in which limits number of cluster heads and increases lifetime of network as well as sleep and awake schedule introduce for removing energy hole and better stability period as well as different power levels introduced for reduces energy consumption and decrease the retransmission of packet, collisions and interference for other signals. So energy consumption is reduced and lifetime increases. In reactive protocol soft threshold and hard threshold reduces number of transmissions. According to simulation results and analysis of proposed schemes, authors say that authors proposed protocol performs better than LEACH and MODLEACH. Lifetime of reactive protocol is much higher than proactive protocol. Researchers enhance proposed protocol in future by using better cluster head selection method as well as better sleep and awake schedule. Also researchers try to simulate this protocol using open source tool and try to put it in real environment.

V. CONCLUSION

Wireless Sensor Networks, which may be spread over a vast geographical area, have their applications in many fields. In this context, there is a need of approaches which can manage these WSNs in a better way possible. In this regard, this paper, presents an improved clustering routing protocol to overcome several limitations of WSNs. Detailed discussion about the existing well-known protocol for WSNs called LEACH and some of its variants is provided.

REFERENCES

[1] N. K. Pandya, H. J. Kathiriya, N. H. Kathiriya and A. D. Pandya, "Design and simulation of enhanced MODLEACH for wireless sensor network," Computing, Communication & Automation (ICCCA), 2015 International Conference on, Noida, 2015, pp. 336-341.

[2] W. R. Heinzelman, A. Chandrakasan and H. Balakrishnan, "Energy-efficient communication protocol for wireless microsensor networks," System Sciences, 2000.Proceedings of the 33rd Annual Hawaii International Conference on, 2000, pp. 10 pp. vol.2-.

[3] M. A. Rahman, S. Anwar, M. I. Pramanik and M. F. Rahman, "A survey on energy efficient routing techniques in Wireless Sensor Network," Advanced Communication Technology (ICACT), 2013 15th International Conference on, PyeongChang, 2013, pp. 200-205.

[4] O. Younis and S. Fahmy, "HEED: a hybrid, energy-efficient, distributed clustering approach for ad hoc sensor networks," in IEEE Transactions on Mobile Computing, vol. 3, no. 4, pp. 366-379, Oct.-Dec. 2004.

[5] M. B. Rasheed, N. Javaid, Z. A. Khan, U. Qasim and M. Ishfaq, "E-HORM: An energy-efficient hole removing mechanism in Wireless Sensor Networks," Electrical and Computer Engineering (CCECE), 2013 26th Annual IEEE Canadian Conference on, Regina, SK, 2013, pp. 1-4.

[6] A. Manjeshwar and D. P. Agrawal, "TEEN: a routing protocol for enhanced efficiency in wireless sensor networks," Parallel and Distributed Processing Symposium., Proceedings 15th International, San Francisco, CA, USA, 2001, pp. 2009-2015.

[7] M. B. Rasheed, N. Javaid, A. Javaid, M. A. Khan, S. H. Bouk, Z. A. Khan, R. D. Khan, "Improving Network Efficiency by Removing Energy Holes in WSNs," Journal of Basic and Applied Scientific Research, ISSN 2090-4304 3(5)253-261, 2013.

[8] V. Sunkara and A. Pal, "Assisted-Leach (A-Leach) Energy Efficient Routing Protocol for WSN," International Journal of Computer and Communication Engineering, Vol. 2, No. 4, July 2013.

[9] D. Mahmood, N. Javaid, S. Mehmood, S. Qureshi, A.M. Memon, T. Zaman, "MODLEACH: a variant of LEACH for WSNs," 26th IEEECanadian Conference on Electrical and Computer Engineering (CCECE2013), Regina, Saskatchewan, Canada, 2013.

[10] S. El Khediri, N. Nasri, A. Wei, A. Kachourid, "A New Approach for Clustering in Wireless Sensors Networks Based on LEACH," Published by ELSEVIER, Procedia Computer Science 32, 1180 – 1185, 2014.

[11] P. N. Renjith and E. Baburaj,"An Analysis on Data Aggregation in Wireless Sensor Networks," IEEE International Conference on Radar Communication and Computing (ICRCC), SKP Engineering College, Tiruvannamalai, TN., India. 21 -22 pp. 62-71, December 2012.

[12] Nikunjkumar K. Pandya, H. J. Kathiriya, N. H. Kathiriya, "Design and simulation of ModHet-LEACH protocol for Wireless Sensor Network," Proceedings of 2nd National Conference on Emerging Trends in Engineering, Technology and Management (NCEETM), ISBN: 978-93-80867-75-5, pp. 45, Indus University, Ahmedabad, India, Jan. 2015.

[13] Nikunjkumar K. Pandya, H. J. Kathiriya, N. H. Kathiriya, A. D. Pandya, "A Review: Energy efficient clustering protocols for Wireless Sensor Network," International Journal of Advance Research In Science And Engineering (IJARSE), ISSN-2319-8354(E), pp. 1010-1017, Vol. No.4, Special Issue (01), March 2015.