ISSN 2395-1621

Extending Lifetime of Wireless Sensor Networks

#1Yash R. Shah, #2Vikrant M. Chitale, #3Parth N. Shah, #4Shreyas U. Nesarikar, #5Prof. Navnath D. Kale

1yashrshah14@gmail.com
2c.vikrant5@gmail.com
3pshah1845@gmail.com
4shreyas.nesarikar@gmail.com
5piyushkale6@gmail.com

#12345Computer Department,
Padmabhooshan Vasantdada Patil Institute of Technology,
Savitribai Phule Pune University
Pune, India

ABSTRACT

Wireless Sensor Networks consist of a number of inexpensive sensor nodes deployed over a wide geographical area for monitoring and reporting activities. As sensor nodes operate on limited battery life, it is important to make efficient use of these nodes by extending their lifetime by employing effective algorithms and switching techniques. Energy management can also be done by deploying spare nodes in place of primary nodes and distribute energy consumption among them. LEACH implements random selection of cluster heads for data transmission to sink nodes/base station. This randomization can be eliminated and instead a calculated decision can be made to assign a cluster head on the basis of factors such as proximity to base station, battery life and strength of transmission link. This way, LEACH can be enhanced to achieve higher efficiency and utilization.

ARTICLE INFO

Article History

Received: 20th January 2017

Received in revised form :

20th January 2017

Accepted: 1st February 2017

Published online :

1st February 2017

Keywords: Wireless sensor networks(WSN), WSN lifetime, energy efficiency

I. INTRODUCTION

Sensor nodes are used to sense or detect activity in the environment and report this to the base station. They have limited battery life as they operate with the help of batteries that have to be physically replaced and cannot be remotely charged. These sensor nodes are small in size and usually cost-effective, thus making it easy to deploy them for monitoring and reporting activities. A Wireless Sensor Network is a group of sensor nodes that are deployed over a geographical region with the primary aim being to be able to observe and understand the activities spanning the given geographical region. WSN is used in a variety of applications such as health care where subjects wear wireless sensors which then reports the data back to the servers, as well as for temperature and pressure monitoring at power-plants, labs, etc. and for package tracking in delivery systems as well as disaster surveillance activities. WSN are also being deployed in the development of smart homes/offices/buildings which help consumers leave a lower carbon footprint by automatically regulating temperatures and air flow.

As WSN has such a wide range of applications, it becomes pivotal to develop methods and techniques which will help these applications grow more secure and effective. WSN has a drawback of having a limited life span and to avoid this limitation to have an adverse impact on critical applications such as in the fields of military and medicine, we need to formulate methods which will help sustain it over a longer period of time than currently possible. WSN lifetime is the time interval starting from the setup phase to the point where reporting activity falls below a certain threshold, specified for the particular application. Extended lifetime also ensures scalability as WSN proves itself to be a mature and cost-effective network.

II. LEACH PROTOCOL

LEACH stands for Low Energy Adaptive Clustering Technology. LEACH mainly focuses on extending the lifetime of WSN and providing a better quality of service. The main goal of LEACH is to be energy efficient and consume least possible energy.

LEACH is a hierarchical protocol which randomly selects the cluster head for the transmission of collected data from the sensor nodes and transmit it to the base station. The

load is evenly transmitted in LEACH protocol so that the node with minimum battery power has a chance to survive more with load balancing facility provided in LEACH protocol.

LEACH protocol works on simple self-adaptive method where a cluster is formed in the sensor network and random selection of cluster head is done. Cluster head have a job for collecting data from other nodes and sending them to the base station. Cluster head schedules TMDA (Time Division Multiple Access) to the sensors nodes within the cluster giving time for transmission and also avoiding the data collision between two sensor nodes. The selection of cluster head changes periodically making LEACH a dynamic protocol with network partition is time variable, the protocol assumes global synchronization.

Working of LEACH

LEACH protocol works in two phases such as:

1. Set up phase
2. Steady state phase

In set up phase the formation of cluster is done in the sensor network with random selection of cluster heads.

In steady state phase the data from other nodes are sent to the cluster head and further transmitted to the base station with the help of TDMA.

III.DRAWBACKS OF LEACH

LEACH being a dynamic and self-adaptive protocol can face various drawbacks and disadvantages. One of the major drawbacks of LEACH protocol is the random selection of cluster head from the cluster. The nodes with low energy remnant also have the same priority to become the cluster head as the node with high energy remnant. This drawback can create an issue in the working of LEACH protocol as the data transmission gets discarded in between if the cluster head battery dies during the communication and data loss is bound to happen.

IV.RELATED WORK

LEACH was proposed by Heinzelman. Zhang introduced the idea of putting sensor nodes to sleep while ensuring complete coverage area. This solution by Zhang is known as the Efficient Power and Coverage Algorithm (EPCA). B.Abu Bakr and L.Lilien proposed DESST (Decentralized Energy-efficient Spare Selection Technique) which talks about management of spare nodes[1]. Vrinda Gupta and Rajoo Pandey talk about energy aware distributed unequal clustering protocols[2].

V. PROPOSED SOLUTION

LEACH proposes random selection of cluster heads which can be detrimental to the network if the assigned cluster head has low battery life. It may lead to the cluster head shutting down midway through the transmission leading to data loss and wastage of time. This drawback can be avoided by eliminating the random assignment of cluster head by a more sophisticated assignment of cluster head on the basis of the strength of transmission link between the node and the base station, the proximity of the node from the base station and the existing battery life of the sensor node. Strength of transmission link ensures data loss is avoided by not sending data over links that are comparatively weak. Proximity to base station accounts in the time factor i.e. the closer the cluster head is to the base station, the less time it will take to transmit information. A comparative analysis is made by taking into account these factors along with the battery life of each individual node to assign a cluster head for a given group of sensors. In principle, this solution is similar to the 'Best first' algorithms that are used in programming to ensure the most optimal choice is selected first.

This solution also ensures that power disparity will be eliminated among nodes as it will employ a balanced and coherent selection policy that will ensure that nodes in the network are assigned the role of cluster head in a timely manner. It will avoid a situation where one node is at a critical battery stage and another is at near-full capacity. The priority to be assigned during the selection of cluster head should be:

1. Battery life
2. Strength of transmission link
3. Proximity to sink node/base station.

Another problem that exists in WSN is selection of spare nodes. Spare nodes are used to avoid data redundancy i.e. nodes covering the same region transmitting the data at the same time thereby leading to redundancy at the server. By employing master-slave configuration, it tried to eliminate this redundancy by keeping only one of the nodes as active and the other as asleep.

This however lead to deadlock condition where both the nodes think the other node is covering the region and both fall asleep, thus leading to lack of coverage and thereafter, loss of information. This situation can be dealt with by applying priorities to primary and spare nodes on the basis of criteria mentioned above which includes battery life and proximity.

In cases of conflict, the sensor node with better battery life and/or close proximity to base station shall act as the active agent taking on the responsibility of covering said geographical region whilst the other node sleeps, saving energy and increasing productivity.

LEACH-SM protocol is an enhancement over LEACH protocol which helps in implementation and efficient usage of spare node.

It considers the following three factors for extending the lifetime of wireless sensor network using spare nodes. The factors are as follows:

1. Spare node selection
2. Spare node management
3. New lifetime of WSN

VI.CONCLUSION

LEACH is a widely used protocol in WSN. The effectiveness and longevity of WSN will receive a boost by implementing the solutions proposed in this paper. The proposed changes surely will add more teeth to a network with varied applications and will surely result in achieving better results in the near future.

REFERENCES

[1] Bilal Abu Bakr, Leszek T. Lilienb, "Extending Lifetime of Wireless Sensor Networks by Management of Spare Nodes", The 2nd International Workshop on Communications and Sensor Networks (ComSense-2014).

[2] Vrinda Gupta, Rajoo Pandey, "An improved energy aware distributed unequal clustering protocol for heterogeneous wireless sensor networks", 2016 Engineering Science and Technology, an International Journal.

