Amandeep Kaur *et al*, International Journal of Computer Science and Mobile Applications,
Vol.5 Issue. 2, February- 2017, pg. 1-8 **ISSN: 2321-8363**
Impact Factor: 4.123

Performance Evaluation of Soft Thresholding Approach for Energy Optimization in Temperature Sensor

Amandeep Kaur
Department of Computer Science, Punjabi University Patiala
amandeepbhangal@ymail.com

Jyotsna Sengupta
Professor at Department of Computer Science, Punjabi University Patiala

Abstract: Energy is the main constraint of wireless sensor networks (WSNs) due to irreplaceable and limited power sources of the sensor nodes. Clustering is the most popular topology control method to reduce energy consumption and improve scalability of WSNs. However, in a cluster based WSN, cluster heads (CHs) consume more energy due to extra work load owing to data collection, data aggregation and their communication to the base station. Various approaches have been used for formation of efficient clustering in WSN so that energy consumption can be reduced. Maximum amount of energy that consumed in WSN is during data transmission. To overcome this problem an approach must be developed that can sense changes occurred in the current sensed value and previous sensed value, so that redundant information can be blocked. We removed energy consumption for working of sensor nodes developing clustering using TEEN protocol & implement soft threshold for reducing redundant information transmission over the network.

Keywords: Wireless Sensor Network, Energy Consumption, Cluster Heads, TEEN Protocols, clustering

1. Introduction

1.1 Wireless Sensor Network

A wireless sensor network is a group of specialized transducers with a communications infrastructure for monitoring and recording conditions at diverse locations. Commonly monitored parameters are temperature, humidity, pressure, wind direction and speed, illumination intensity, vibration intensity, sound intensity, power-line voltage, chemical concentrations, pollutant levels and vital body functions. The more modern networks are bi-directional, also enabling control of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

1.2 Temperature sensing in WSN

1.2.1 Temperature sensors

Temperature sensors detect a change in a physical parameter (resistance or output voltage) that corresponds to a temperature change.

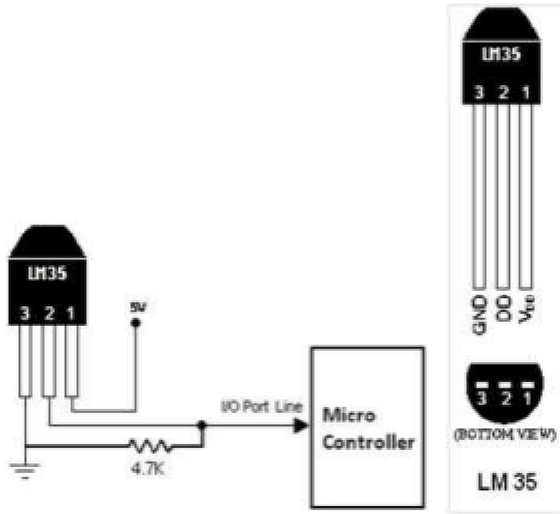

Figure.1.1 Temperature Sensor

Three basic types of temperature sensors are electro-mechanical, electronic, and thermo-resistive. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. It is low cost and small size sensor. Its temperature range is -55° to +150°C.

1.2.2 Electromechanical temperature sensors These sensors are based on expanding or contracting properties of materials when subjected to a temperature change. Bi-metal thermostats are created by bonding two metals into a single strip of material. Different expansion rates of the metals create electromechanical motion when the material is subjected to a temperature change. In capillary thermostats the capillary motion of expanding or contracting fluid is used to make or break a number of electrical contacts.

1.2.3 Resistive Temperature sensors

Resistive temperature sensors are devices whose resistance changes with the temperature.

1.2.4 Thermostats

A thermostat is a type of resistor with resistance varying according to its temperature. They typically consist of a combination of two or three metal oxides that are sintered in a ceramic base material. Thermostats can be classified into two types: positive temperature coefficient (PTC) and negative temperature coefficient (NTC). PTC devices exhibit an increase in resistance as temperature rises, while NTC devices exhibit a decrease in resistance when temperature increases. The main disadvantage of the thermostat is its strong non-linearity. Cheap thermostats have large spread of parameters (“tolerance”) and calibration is usually necessary.

1.2.5 Resistive temperature detectors (RTDs) unlike thermostats that use a combination of metal oxides and ceramics resistive temperature detectors are made from pure metal (copper, nickel or platinum are usually used). RTDs are useful over larger temperature ranges, while thermostats typically achieve a higher precision within a limited temperature range. As a RTD is a resistance device and it needs measuring current to generate a useful signal. Because this current heats the element above the ambient temperature (P = I2.R), errors can occur, unless the extra heat is dispersed. This forces us to choose a small-sized resistance device with a quick response or a larger resistance device and better heat release. A second solution is to keep the measuring current low (usually between 1 mA and 5 mA).

1.3 Routing protocols in WSN

1.3.1 Proactive Protocols

Proactive routing protocols are also known as table driven protocols which maintains consistent and accurate routing tables of all network nodes using periodic dissemination of routing information. In this category of routing all routes are computed before their needs [paper]. Most of these routing protocols can be used both in flat and hierarchal structured networks. The advantage of flat proactive routing is its ability to compute optimal path which requires overhead for this computation which is not acceptable in many environments. While to meet the routing demands for larger ad hoc networks, hierarchal proactive routing is the better solution.

1.3.2 Reactive Protocols
Reactive routing strategies do not maintains the global information of all the nodes in a network rather the route establishment between source and destination is based on its dynamic search according to demand.
In order to discover route from source to destination a route discovery query and the reverse path is used for the query replies. Hence, in reactive routing strategies, route selection is on demand using route querying before route establishment. These strategies are different by two ways: by re-establishing and re-computing the path in case of failure occurrence and by reducing communication overhead caused by flooding on networks.

1.3.3 Hybrid Protocols
This strategy is applied to large networks. Hybrid routing strategies contain both proactive and reactive routing strategies. It uses clustering technique which makes the network stable and scalable. The network cloud is divided into many clusters and these clusters are maintained dynamically if a node is added or leave a particular cluster. This strategy uses proactive technique when routing is needed within clusters and reactive technique when routing is needed across the clusters. Hybrid routing exhibit network overhead required maintaining clusters Architecture Based Routing Protocols are divided according to the structure of network which is very crucial for the required operation. The protocols included into this category are further divided into three subcategories according to their functionalities. These protocols are

- Flat-based routing
- Hierarchical-based routing
- Location-based routing

1.3.4 Multipath Routing Protocols
As its name implies, protocols included in this c lass provides multiple path selection for a message to reach destination thus decreasing delay and increasing network performance. Network reliability is achieved due to increased overhead. Since network paths are kept alive by sending periodic messages and hence consume greater energy. Multipath routing protocols are:

- Multi path and Multi SPEED (MMSPEED)
- Sensor Protocols for Information via Negotiation (SPIN)

1.3.5 QueryBased Routing Protocols
This class of protocols works on sending and receiving queries for data. The destination node sends query of interest from a node through network and node with this interest matches the query and send back to the node which initiated the query. The query normally uses sigh level languages.
Query based routing protocols are:

- Sensor Protocols for Information via Negotiation (SPIN)
- Directed Diffusion (DD)
- COUGAR

2. Review of Literature

Md Azharuddin *et al.* proposed that the main problem of WSN is to reduce energy consumption and limited power sources of the sensor nodes. To reduce the energy consumption, clustering is the main method and increases the scalability. In a cluster based WSN, cluster heads (CHs) consume more energy due to extra work load owing to data collection, data aggregation and their communication to the base station. So, the efficient cluster formation is very challenging by considering the energy consumption of the CHs. This is also very difficult with the fault tolerant issue of WSNs as the sensor nodes are prone to failure. Thus, a distributed fault-tolerant clustering algorithm called DFCA was introduced which uses a cost function of the CHs for the formation of cluster and also presented a distributed run time recovery of the sensor nodes from the faulty cluster due to sudden failure of the CH [1].
Jayashri D. Gaurkar et al. carried out a review on routing protocol in WSNs which are classified as data-centric, hierarchical and location based depending on the network structure[2]. Multipath routing protocols improve the load balancing and quality of service in WSN and also provide reliable communication. Energy Efficient and Reliable Routing Protocol (EERRP) uses clustering propagation delay and loss of packets.

Das, T et al this paper proposing Target tracking is one of the most popular applications of mobile wireless sensor networks (MWSNs), where coverage and data gathering algorithms are foundations to achieve successful target tracking [3]. Since the mobility of sensor nodes is of great importance in this particular class of application, it is crucial to design efficient techniques that can manage the mobility.

Zhou Xin-lian et al proposing This paper presents one inner-cluster scheduling algorithm, avoiding mobile nodes' location affect, satisfying expected coverage scale and high-effect. This excludes the number of smallest inner-cluster active nodes k, which can satisfy expected coverage scale in monitored area, according to coverage analysis theory [4]..

Gagneja, K. K et al proposed Heterogeneous Sensor Networks are more powerful and efficient than homogeneous sensor networks [5]. shown that homogeneous sensor networks perform poorly because of routine limits and scalability.

Jambli, M.N. et al this paper proposing saving energy is a very critical issue in wireless sensor networks (WSNs) because sensor nodes have severe resource constraints such as lack of processing power and limited in power supply [6].

3. Performance Parameters

3.1 Packet Loss

Packet loss occurs when one or more packets of data travelling across a computer network fail to reach their destination. Packet loss is typically caused by network congestion. Packet loss is measured as a percentage of packets lost with respect to packets sent.

$$P_l = \frac{(T_p - T_d)}{T_p} \qquad (3)$$

3.2 Packet Delay

The sum of store-and-forward delay that a packet experiences in each router gives the transfer or queuing delay of that packet across the network. Packet transfer delay is influenced by the level of network congestion and the number of routers along the way of transmission.

$$D = (T_r - T_s) \qquad (4)$$

3.3 Throughput

It is the number of packets/bytes received by source per unit time. It is an important metric for analyzing network protocols.

$$Th = \frac{T_d * S}{Time} \qquad (5)$$

3.4 Packet Delivery Ratio (PDR)

It is the ratio of actual packet delivered to total packets sent. The following table shows the values of the various parameters used during simulation of these protocols.

$$P_l = \frac{T_d}{T_p} \qquad (6)$$

Where T_d, represents total number of packets delivered from source to destination, T_p, represents total number of packets send from source to destination, T_r, represents packet receiving time, T_s, represents packet sending time, S, represents size of message transmitted.

3.5 Network Lifetime

Network lifetime is perhaps the most important metric for the evaluation of sensor networks. Of course, in a resource-constrained environment, the consumption of every hierarchical structure to efficiently decrease the amount of data transmissions between nodes and the base station (BS). EERRP is able to improve the reliability of the traffic transmission, in the same time reduce the energy consumption of the whole network. Saving the nodes energy leads to an increase in the node life in the network, in comparison with the other protocols. Furthermore, the protocol reduces limited resource must be considered. However, network lifetime as a measure for energy consumption occupies the exceptional position that it forms an upper bound for the utility of the sensor network. The network can only fulfill its purpose as long as it is considered "alive", but not after that. It is therefore an indicator for the maximum utility a sensor network can provide. If the metric is used in an analysis preceding a real-life deployment, the estimated network lifetime can also contribute to justifying the cost of the deployment. Lifetime is also considered a fundamental parameter in the context of availability and security in network.

3.6 Average Energy Dissipation

This metric shows the average dissipation of energy per node over time in the network as it performs various functions such as transmitting, receiving, sensing, aggregation of data etc. in the process of communication nodes consume various amount of energy under different operations performed by these nodes. In the proposed work energy dissipated by the entire nodes that are available in the network has been measured and average has been computed after each round.

4. Results and Discussion

In the result section simulation has been done for sensing the information from the sensing environment. In this chapter simulation of WSN has been reported. In the process of simulation different parameters have been analyzed for performance evaluation of proposed work. In the proposed work simulation parameters have been initialized for WSN. These parameters are described below.

Table 4.1 Simulation parameters setup

Parameter	Description
Area	100 * 100
Number of nodes	200
Antenna	Omni
Routing Protocol	TEEN
MAC Type	8.02/11
Receiving Energy	$50*10^{-8}$
Transmission Energy	$50*10^{-8}$
Initial Energy	100 Jules
Energy Model	ENERGY Model

Table 4.1 defines various simulation parameters that are necessary for simulation of the proposed work. In the process on WSN these parameters are utilized for initialization of the simulation setup. In the WSN 200 nodes have been deployed in the network that has been used for sensing information and transmitting information to base station. These nodes that have been deployed at random positions for sensing information from surroundings. In the simulation of proposed model temperature sensors have been deployed that use threshold value to transmit information from sensor node to base station. On the basis of sensed value and soft threshold value that measure minimum difference between previous sensed value and new sensed value. If the difference is higher than that of soft threshold value then nodes will transmit information else the redundant information has been discarded by the network that save energy as well as network bandwidth.
On the basis of routing protocol route has been selected for data transmission to base station via various cluster heads. In the process of data transmission a cluster member transmit sensed information to cluster head and cluster head transmit to other cluster head that have route to transmit information to base station.

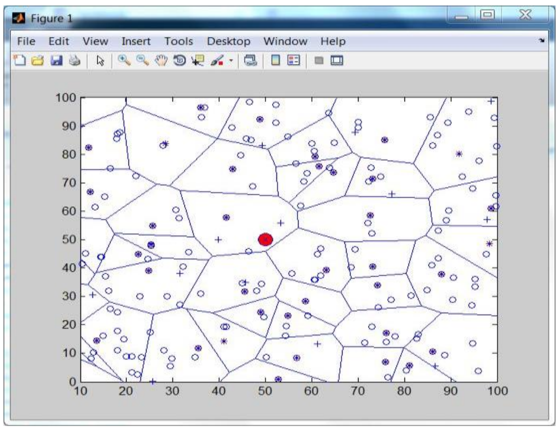

Figure 4.1 WSN deployed

This figure represents WSN that has been used for sensing information from the sensing environment. That information has been transmitted over the network base station via intermediate nodes for decision making process. 200 nodes have been deployed over the network area that has been used for capturing information.

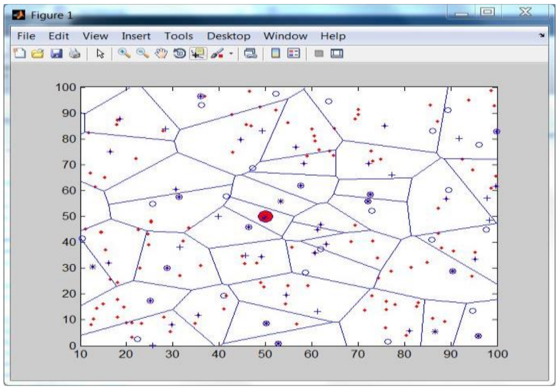

Figure 4.2 Data transition and Receiving

In the process of WSN data has been transmitted by sensor nodes using routing strategy. In these process nodes consumes transmission, receiving and data aggregation energy. In the process of WSN energy consumption is major issue for network performance measurement. Soft threshold has been used that has been based on the principle of critical information transmission on the basis of threshold limit. Information that has been below the threshold limits have to be sensed to base station and all neighbor nodes. But normal information of the nodes that transmitted in many messages has been blocked. This conversion reduces consumption in energy that can increase lifetime of the network.

- Comparative Analysis with Existing approaches

In the process of WSN various approaches have been purposed that works on the principal of clustering. Clustering approaches divides whole network into different clusters and these clusters has been used for selection of cluster head**.** Various approaches that are LEACH, DEEC and TEEN with hard and soft threshold has been compared on the basis of performance evaluation parameters that are illustrated below.

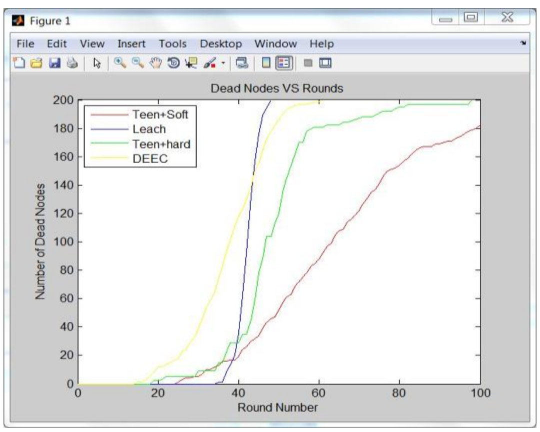

Figure 4.3 Network Lifetime

This figure represents network lifetime that has been achieved by the WSN using proposed approach. In this process different nodes energy has been exhausted in the processing of data transmission. Network lifetime has been measured on the basis of last node dead during number of rounds of simulation. In the processing of WSN various approaches have been used for data sensing and transmission from a particular area. In this proposed work proposed method has been compared with leach, DEEC and hard threshold with TEEN. On the basis of network lifetime parameter comparison proposed approach Soft threshold with TEEN approach provides better network lifetime over the other approaches.

IJCSMA
Amandeep Kaur *et al*, International Journal of Computer Science and Mobile Applications,
Vol.5 Issue. 2, February- 2017, pg. 1-8 **ISSN: 2321-8363**
Impact Factor: 4.123

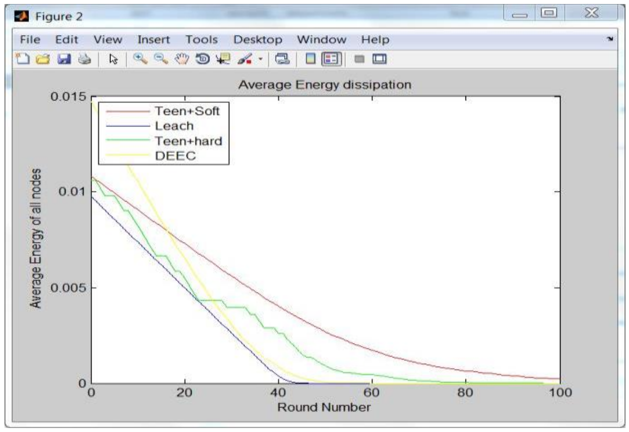

Figure 4.4 Average Energy dissipation in rounds

This figure represents average amount of energy available in the network after completion of a single round. In this process different nodes energy has been exhausted in the processing of data transmission. Average amount of energy has been measured by using ratio of overall residual energy having all the nodes to total number of nodes available in the network. Various approaches have been simulated for wireless sensor network that have been used for data transmission from sensor nodes to base station. On the basis of performance evaluation parameters soft threshold with TEEN out of all approaches provide less average energy dissipation in single round. Due to minimum energy dissipation long network lifetime and higher throughput has been provided by system.

Table 4.2 Dead and Alive Nodes in Rounds using various Approaches

Parameters	Soft	Hard	Leach	DEEC
Number of alive nodes	18	2	0	0
Number of Dead Nodes	182	198	200	200
First Node dead (ROUND)	22	16	18	16

This table represents number of nodes that are alive and that are dead in 100 rounds of simulation using various approaches of data transmission. 200 nodes have been deployed over the network so that network performance can be measured. In this table network stability period has been represents by fist node dead in which round. Network stability period defines lifetime of the network for which all the nodes that are available in the network are in idle state.

5. Conclusion

WSN is the emerging field of communication for transmission of sensing information from the sensing environment using different sensor nodes. In the proposed work TEEN routing protocol has been simulated using hard and soft threshold mechanism. Threshold in WSN is an approach that has been used for transmission of different information's on the basis of different threshold limits that has been initialized. On the basis of these threshold values hard and soft threshold values redundant information does not transmitted again and again to the cluster head that decrease in data aggregation and transmission energy. Soft threshold has been defined in the network so that small change in sensed value that has been sensed by the node must be greater or less that previous sensed value that has been transmitted in previous round by the node. This redundancy in data transmission causes network overhead and wastage of network bandwidth. In the proposed work soft threshold used for data transmission reduced network overhead due to routing packets and reduction in energy consumption. In the proposed work

IJCSMA

Amandeep Kaur *et al*, International Journal of Computer Science and Mobile Applications,
Vol.5 Issue. 2, February- 2017, pg. 1-8 **ISSN: 2321-8363**
Impact Factor: 4.123

network performance has been measured on the basis of energy consumed and network lifetime. These performance evaluation parameters are important tool for measurement of actual importance in routine activities of proposed model. On the basis of these performance evaluation parameters one can conclude that proposed approach provide better network lifetime as well as energy dissipation in the network.

6. Future Scope

WSN is part of networking that comprises various nodes deployed in the environmental area for sensing information. In the proposed work an approach that work with TEEN protocol for energy optimization using soft threshold has been used. In future reference proposed model can be used in real world applications for data capturing. Artificial intelligence approaches can be used in future for selection of best route to transmit data so that energy can be conserved.

References

[1] R. U. Anitha and P. Kamalakkannan, "Energy efficient cluster head selection algorithm in mobile wireless sensor networks," in 2013 International Conference on Computer Communication and Informatics, 2013, pp. 1–5.

[2] S. Yadav and S. S. Yadav, "Review for Leach Protocol in WSN," Int. J. Recent Dev. Eng. Technol., vol. 2, no. 6, pp. 69–71, 2014

[3] Hong-Ling Shi "Energy Efficient and Fault Tolerant Multicore Wireless Sensor Network: E²MWSN", IEEE Conf on Wireless Communications, Networking and Mobile Computing (WiCOM), 2011, pp 1 – 4.

[4] Das, T "Employing cooperative group mobility model for mobile target tracking in MWSN", IEEE Conf. on Applications and Innovations in Mobile Computing (AIMoC), 2015, pp. 55 – 61.

[5] Zhou Xin-lian "The Research of Inner-cluster Nodes Scheduling Algorithm in mWSN", IEEE Conf on Information Technology and Applications (IFITA), 2011, pp. 131 – 134.

[6] Gagneja, K.K "Heuristic clustering with secured routing in Heterogeneous Sensor Networks" IEEE Conf. on Security and Privacy of Mobile, Wireless, and Sensor Networks (MWSN), 2013, pp. 9 – 16.

[7] Jambli, M.N. "Transmission power control in mobile wireless sensor networks: Simulation-based approach", IEEE Conf. on Wireless Communications and Applications (ICWCA 2012),, 2012, pp. 1 - 6

[8] M. P. Singh and D. K. Singh, "Routing Protocols in Wireless Sensor Networks –A Survey," Int. J. Comput. Sci. Eng. Surv., vol. 1, no. 2, pp. 63–83, 2010.

[9] R. U. Anitha and P. Kamalakkannan, "Enhanced cluster based routing protocol for mobile nodes in wireless sensor network," in 2013 International Conference on Pattern Recognition, Informatics and Mobile Engineering, 2013, pp. 187–193.

[10] R. U. Anitha, "EEDBC-M : Enhancement of Leach-Mobile protocol with Energy Efficient Density-based Clustering for Mobile Sensor Networks (MSNs)," Int. J. Computer Appl., vol. 74, no. 14, pp. 19–27, 2013.