Energy Efficient Approach for Data Aggregation in Wireless Sensor Networks

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Abstract **-** Wireless sensor network is similar to adhoc networks, which is senses the information and reply back to their base stations. Wireless sensor networks are used to collect the information from physically and environmental conditions. WSN is decentralized network, which is deployed far places due to this sensor nodes have small size, that's why here energy consumption of the sensor nodes is major issue. In this research work, clustering approach is used to grow the energy level of sensor nodes. For data aggregation the cluster heads are selected in this approach. To grow up the energy level of sensor nodes the fuzzy logic rules are derived that on based upon some parameters in the network like, node energy, distance from base station, and selection of cluster heads. To implement this proposed scheme some parameters are used like, number of transmitted packets, number of dead senor nodes, throughput of the network and remaining energy. This whole scenario is implements in NS2.

Keywords- Energy Efficient, LEACH, Two-Level Hierarchy, NS2

I. INTRODUCTION

A set of tiny devices known as nodes that help in monitoring the surrounding area collectively generate a wireless sensor network (WSN). The various physical attributes of the surrounding area are measured with the help of the the sensor nodes deployed within those regions that are required to be monitored. There are around thousands of sensor nodes present within these networks that use wireless mode for communicating amongst each other. In order to connect the sensor network with the external environment, a special node which is known as base station or the sink node is available within the network [1]. There are highly limited number of sensor nodes present within these networks. It is important to ensure that the sensor nodes that are to be deployed over large areas are very less costly due to which the components included within them are also of minimal cost. Therefore, least cost of components are used to generate the sensor nodes such that the structure of these nodes is very similar to that of the modern devices. There is minimal hardware design involved in these networks which results in generating such unique properties as well as limitations to these networks. The sensor nodes present in the network include batteries within them with the help of which various operations are performed. Thus, the overall lifetime of the wireless sensor networks is determined by the factor known as energy consumption. In these networks, the complications of energy optimization are higher since there is a need to increase the lifetime of the network along with the minimization of amount of energy being consumed. By generating energy awareness within each design and operation aspect, it is possible to perform optimization [2]. Thus, it is made sure that within the groups of communicating sensor nodes and the overall network, the energy awareness is done along with focusing on each of the sensor nodes through this approach. Sensing the data available in surrounding environments is the most important task of sensor nodes of WSNs. Within multi-hop scenarios, it is important to provide routing path for transmitting the gathered data towards the base station using multi-hop. There are large numbers of routing protocols proposed such that a routing path can be defined from source node to the base station. The power as well as resource limitations of the sensor nodes are important to be considered during the designing of routing protocols for WSNs [3]. Further, the time-varying quality of wireless channels as well as the possibility of packet loss and delay is required to be considered here as well. Various routing mechanisms are proposed for WSNs such that the design requirements can be addressed in these networks. A flat network-architecture is adapted by the initial class of routing protocols. Here all nodes that exist within the network are known as peers. Providing least overhead for the maintenance of infrastructure and discovering the various routes possible amongst the communicating nodes to ensure fault tolerance are some of the benefits of the flat network architecture [4]. A mechanism through which the path can be discovered and information can be disseminated from the wired as well as wireless ad hoc networks is known as flooding. The maintenance of costly network topology and complex route discovery algorithms are not the factors to be considered here as it is very simple to be executed. Gossiping is the derivative approach that is applied for addressing the disadvantages of flooding. A simple forwarding rule is utilized by gossiping which is very similar to flooding. However, there is no need of costly topology maintenance or complex route discovery of the algorithms in this approach [5]. The data packet is forwarded to all the neighbors in flooding which is however not found in this approach. A data-centric negotiation-based family of the information

dissemination protocols is known as SPIN. The efficient dissemination of observations that the individual sensor nodes collect from all other sensor nodes in an efficient manner is the prior objective of these protocols. To achieving information dissemination within WSNs, it is possible to propose simple protocols like flooding and gossiping. A copy of data packet is forwarded to all the neighbors by each node in flooding till all the nodes present in the network receive this information. For collecting and delivering the data towards the sink or base station, LEACH routing algorithm is used. A hierarchical technique is used by LEACH such that a set of clusters is generated through which the network is organized. A cluster head is chosen for managing each cluster. Multiple tasks are performed for assuming cluster heads [6]. From the members of the cluster, the data is collected periodically in the initial task. In this section the two protocols namely TEEN (Threshold-sensitive Energy Efficient sensor Network protocol), and APTEEN (Adaptive Periodic Threshold-sensitive Energy Efficient sensor Network protocol) are studied which are used within the applications that are time dependent. The medium is sensed in continuous manner by the sensor nodes in TEEN. However, there is less frequent data transmission performed. A hard threshold is performed by the members of a cluster head here which is known to be the value of sensed attribute.

II. LITERATURE REVIEW

Ram Murthy Garimella, et.al (2018) presented an essential role is played by the energy efficiency in the wireless sensor network. In order to utilize the efficient energy techniques in the wireless sensor networks for the process of data gathering and routing, they utilized the concept of the Hessian matrix in this paper [7]. This concept was utilized for the validation of the proposed method having the multi variable calculus. These wirelesses sensor nodes are distributed in the multidimensional space is the assumption on which it is based. On the basis of performed experiment, it is illustrated that proposed method can be utilized in any clustering approach using its mathematical design and provides the low-energy communication structure.

Deepa PUNEETH, et.al (2018) presented there are some criterion such as energy efficiency, data reliability, and security that must be fulfilled in the wireless sensor networks. The desired reliability and information-theoretic security has been provided by the Shamir's secret sharing (SSS) which is not provided optimal results for energy efficient. Therefore, they provided the Shamir's ramp secret sharing (SRSS) in this paper using which energy efficiency and data reliability is obtained [8]. The combination of SRSS and a round-reduced AES cipher was there main objective which collectively called as "split hop AES (SHAES)". For the validation of the method near-sink CN attack, they performed various analyses and used simulation results and concluded proposed method superior to other methods.

Peijun Zhong, et.al, (2018) presented with the emerging technology and fast development in the wireless sensor networks applications leads to proposed more energy efficient routing algorithms. They discussed the major challenge in this paper that of how to overcome the hot spot problem since nodes close to base station tend to die earlier than other sensors. Therefore, this issue is alleviated effectively after introducing the concept of mobile sink node [9]. As these sink node can move along certain trajectories due to which nodes of hot spot can be distributed evenly in all direction. They studied the energy efficient routing method in detailed in this paper supported by the multiple mobile sinks. They performed various experiments for which they divided the whole network into several clusters after which investigated the effects of mobile sink on the network lifetime.

Fawaz Alassery, et.al (2017) used the virtual MIMO technique for high energy efficiency smart WSN [10]. In this approach the data is transmitted through two circumstances. In the first case, the source node received data from one rechargeable relay node that is deployed in the centre of sensing nodes and then these packets are forward to destination node. In second case, the whole sensing nodes are divided into clusters and in each cluster have its own rechargeable relay node is used to forward the data to destination node. The experiments are done by them on both cases, but the second case gave the better results because in this technique the clusters used. In this technique there is direct data transmission in each cluster due to clustering technique and the central relay nodes.

Mehdi Kalantari, et.al (2017) presented routing in the wireless sensor networks is very necessary due to which they proposed a new scheme in this paper. It is based on the concept in which data is collected by the various sensors and transfer it to a central node [11]. In electrostatic theory, Maxwell's equation is very similar to partial differential equation, in proposed method. By using these equations in the networks the best routes are find out which gives the energy efficiency**.** They approximated the identified paths using a sequence of wireless links each between a pair of sensors in order to find the actual routes. As per done simulation and obtained results, it is demonstrated that there is improvement in the network lifetime as compared to other traditional shortest path approach.

M. D. Umale1, et.al (2015) presented various approaches such as cross layer energy efficient model with two modulation scheme Frequency shift keying (FSK) and Pulse Position modulation (PPM) using which issue of energy consumption can be solved [12]. Using this method nodes are

deployed randomly in small scale WSN. In the multiple target coverage problems (MTC), the issue energy consumption is solved by the third technique on which two sensors scheduling scheme is used such as optimization scheme and other is heuristic scheme. There are some limitations in the above mentioned approaches of dynamic energy management due to which the target tracking concept of WSN was proposed as it provides the effective energy management. Therefore, the target tracking, the grid exclusion and Dijkstra algorithm used for coverage metric and energy metric respectively.

III. RESEARCH METHODOLOGY

The proposed methodology is based on the selection of cluster head for the data transmission, for the selection of cache nodes which aggregate data to the base station.

Step 1: Cluster head selection: One of the requirements of clustered WSNs application is the monotony distribution of nodes. Balanced cluster heads are generated here that have several benefits of their own due to the suitable distribution conducted here. A HELLO-MSG is broadcasted that holds ID within it, in the entire network as the initial step. The distance of base station from each node is calculated here on the basis of signal strength attained and an INITIAL-MSG is broadcasted all over the network in which the ID and the distance of node to the base station are present. From that node, the adjacent nodes can possibly compute their distances. Equation (1) presents the calculation method that is used by each node to compute its cluster head R_{CH} as:

$$\square_{\square\square} = \square_{\square\square\square} * [I + (\frac{\square_{\square\square} - \square_{\square\square\square\square\square}}{\square_{\square\square\square\square\square} - \square_{\square\square\square\square\square}})] \quad \ldots(1)$$

Here, the minimum cluster size is denoted by $R_{min}$and is also included as parameters of protocol. The distance amongst nearest node and the Base station is denoted as $\square_{\square\square\square\square\square}$. The distance amongst farthest node and base station is denoted by $\square_{\square\square\square\square\square}$.

$$\square_{\square\square-\square\square\square\square\square} = \square * \square_{\square\square\square} + \frac{\square}{\square\square\square_{\square\square\square}} + \frac{\square}{\square_{\square\square}} \ldots (2)$$

In the above equation, the constant weights amongst zero and one where sum is equal to one are represented as α, β and □. These values are similar as well as adjustable for all the nodes present in the network. The number of neighboring nodes that have $\square_{\square\square}$ radius are denoted by $\square_{\square\square\square}$. The mean square of distance amongst the neighboring nodes with $\square_{\square\square}$ radius is denoted by $\square\square\square_{\square\square\square}$. The distance amongst each node and base station is represented by $\square_{\square\square}$.

Step 2: Cache node selection: There are certain factors on which the intra-cluster communication within an energy cluster depends.

The nodes that are within the unsuitable conditions as cache nodes are not chosen by the intended standards. For a node to be chosen as volunteer cache node, each non-cluster head node determines a value within this step.

$$\text{Access Time} = H*Tc+(1-H)(Tc+Tm) \quad \ldots(3)$$

In the equation 3, H is the cache hit ratio, Tc is the access time , (1-H) cache miss ratio, Tm is the main memory access time. The cache which has least access time is selected maximum time for the data aggregation from the cluster heads. The cluster heads will send the data to the base station.

IV. EXPERIMENTAL RESULTS

The proposed approach is implemented in NS2 and evaluated in terms of throughput and energy by making comparisons against existing approach.

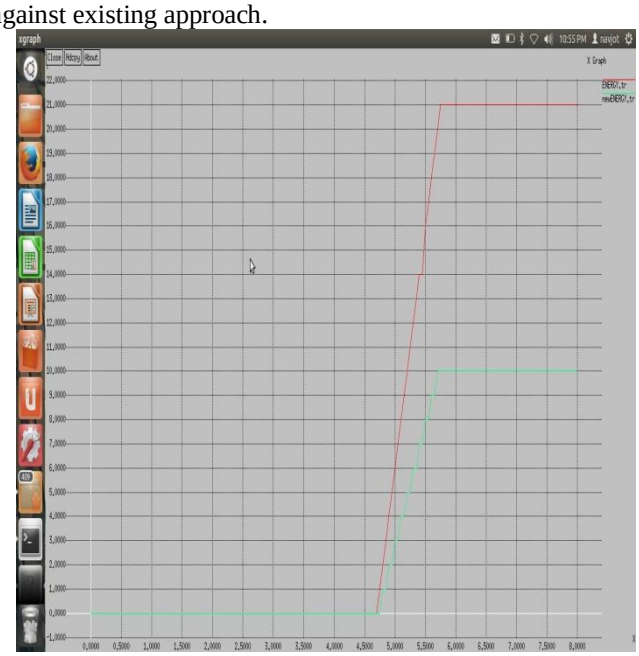

Fig.1: Energy Consumption Comparison

As shown in figure 1, the performance of fuzzy and cache protocol is compared in terms of energy consumption. It is analyzed that energy consumption of cache protocol is low as compared to fuzzy protocol

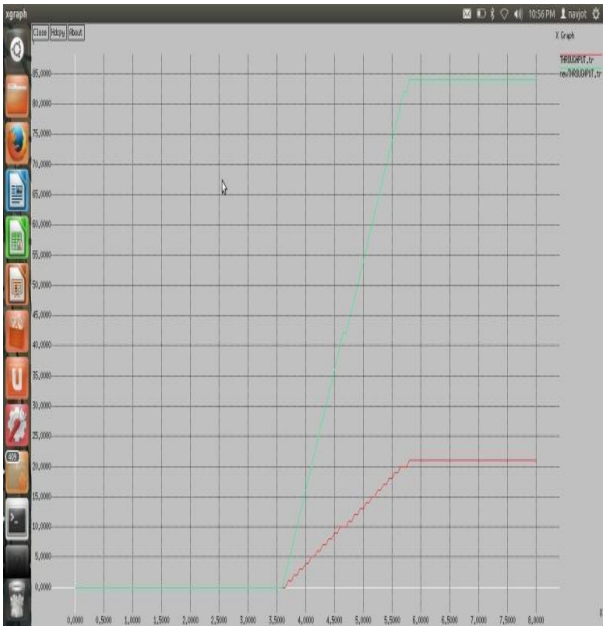

Fig.2: Throughput Comparison

As shown in figure 2, the fuzzy and cache protocols are compared in terms of number of throughput. The throughput of the fuzzy protocol is high as compared to the cache protocol.

V. CONCLUSION

There is an increase in demand of wireless sensor networks today. There are different types of sensor nodes present within the networks. The applications are completely based on the several types of sensors involved within them. In the research work, the cache nodes are deployed in the network. The cluster heads aggregate data to cache nodes. The cache nodes will transmit data to base station. The cache nodes maintain the flash memory which improve lifetime of sensor networks. The simulation of proposed model is performed in NS2 and result shows that proposed technique performs well in terms of packet transmission and number of dead nodes, network lifetime, throughput and remaining energy as compared to existing technique.

VI. REFERENCES

[1]. D. F. Yildiz and K. L. Coogler, Low Power Energy Harvesting with a Thermoelectric Generator through an Air Conditioning Condenser in 121st ASEE Annual Conference & Exposition, Indianapolis, 2014.

[2]. M. A. Green, K. Emery, Y. Hishikawa, Warta and E. D. Dunlop, Solar cell efficiency tables (version 39), Progress in Photovoltaics: Research and Applications, vol. 20, no. 1, p. 1220, 2012.

[3]. S. Roundy, D. Steingart, L. Frechette, P. Wright and J. Rabaey, Power sources for wireless sensor networks, Springer Berlin Heidelberg, vol. 29, no. 20, pp. 1-17.2004

[4]. Anuj, Wireless Sensor Network: A Review On Data Aggregation International Journal of Innovations in Applied Sciences & Engineering, ISSN: 2454-9258, vol. 2, pp. 11-17, 2016.

[5]. Faheem khan, Sohail abbas, Samiullah khan, An Efficient and Reliable Core-Assisted Multicast Routing Protocol in Mobile Ad-Hoc Network, International Journal of Advanced Computer Science and Applications, vol7:5, 2016.

[6]. M. J. Usman, Z. Xing, H. Chiroma, A. Y. U. Gital, A. I. Abubakar, A. M. Usman and Herawan, Modified Low-Energy Adaptive Clustering Hierarchy Protocol for Efficient Energy Consumption in Wireless Sensor Networks for Healthcare Applications, International Review on Computers and Software, vol. 9, no. 11, pp. 1904-1915, 2014.

[7]. Ram Murthy Garimella, Damodar Reddy Edla, Venkatanareshbabu Kuppili, "Energy Efficient Design of Wireless Sensor Network: Clustering", IEEE, 2018

[8]. Deepa PUNEETH, Nishanth JOSHI, Pradeep Kumar ATREY, "Energy-efficient and reliable data collection in wireless sensor networks", Turkish Journal of Electrical Engineering & Computer Sciences, 2018

[9]. Peijun Zhong and Feng Ruan 2, "An energy efficient multiple mobile sinks based routing algorithm for wireless sensor networks", IOP Conference Series: Materials Science and Engineering, 2018

[10]. Fawaz Alassery, "A Virtual MIMO Transmission Scenarios for High Energy Efficiency Smart Wireless Sensor Networks over Rayleigh Flat Fading Channel", IEEE, 2017

[11]. Mehdi Kalantari and Mark Shayman, "Energy Efficient Routing in Wireless Sensor Networks", IEEE, 2017

[12]. M. D. Umale, S. S. Awate, V. N. Gavali, "Energy Efficient Techniques in WSN: A Review", Energy Efficient Techniques in WSN: A Review, Volume: 02 Issue: 03 | June-2015