Middle-East Journal of Scientific Research 24 (S2): 313-318, 2016
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2016.24.S2.213

An Energy Efficient Distributed Algorithmfor Maximizing Life Time of Wireless Sensornetworks

[1]C. vennila and [2]B. Rama prabha

[1]Professor, Department of ECE, Saranathan college of engineering, Trichy, Tamilnadu, India
[2]PG scholar, Department of ECE, Saranathan college of engineering, Trichy, Tamilnadu, India

Abstract: Wireless sensor networks (WSN) often consist of a large number of low-cost sensor nodes that have strictly limited computation capabilities. WSN are usually deployed in remote environments to transmit sensed information to the Base Station (BS). Nodes are split into clusters using region based clustering. At the beginning of every round the CH head wait for the re-clustering message. If cluster head didn't receive re-clustering message, same cluster will continue the aggregation process. Hybrid energy efficient distributed clustering (HEED) algorithm is used to select the cluster head according to the residual energy. Routing between the nodes is done by cluster based routing protocol.

Key words: WSN · Sensor nodes · Sink node · CBRP · HEED · Region based clustering

INTRODUCTION

Wireless Sensor Network (WSN) computing the changes in the physical environmental conditions using number of sensors [1]. A WSN is basically composed of a sink and several sensor nodes distributed over a certain geographical area. Sensor nodes monitor the environment and collect information such as temperature, humidity, pressure, vibration, sound and so on. Each node in a WSN report the information it gathered to the base station directly or through multi hop wireless communication link. The components of a sensor node have various operation modes.

The processor can be either in active, idle or sleep mode. The sensors can operate either in active or sleep mode. The transceiver can be either transmitting, listening, or off. Each combination of these devices operational mode characterizes different states. Based on these components operation mode combination, sensor nodes mode of operation can be broadly categorized into four; active, listen, sense and sleep.Typically, sensor nodes are energy constrained, batteries as energy source of sensors. The life time of a WSN is also limited Due to energy constraints. Because of the nature of the applications in which WSNs are used, it is usually very difficult to reach every node and replace their batteries. Several methods have been proposed such as power efficient components, energy aware protocols to minimize the energy consumption in each node and increase the life time of the network.

Fig 1 shows the main building blocks of a sensor node and their process. Monitor changes in the environment by Sensor nodes using their sensors devices. Diagnosis, refinement and data collection are the main activities of a sensor node, which causes energy depletion [2]. Data communication accounts for consuming most of the energy stored in the battery, but the energy consumed in sensing and processing cannot be neglected as well.Centralized network routing is default routing, total network is collapsed if anyone of the node get fails. so that validity of the network is

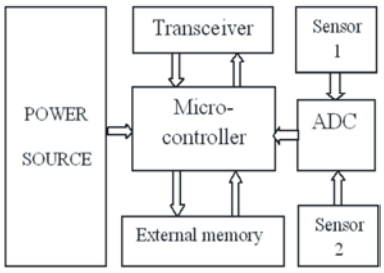

Fig. 1: Components of sensor network

Corresponding Author: C. Vennila, Professor, Department of ECE, Saranathan College of Engineering, Trichy, Tamilnadu, India.

increased using the distributed network. Routing is formed during the data transmission only it will not be a permanent routing. Advantage of distributed network is sensor nodes are prone to failure, better collection of data; provide nodes with backup in case of failure of the central node.Wireless Sensor Networks Energy Efficiency [3] are Limited storage and computation, Low bandwidth and high error rates, the capability of a system to a large number of sensor nodes, the ability to remain alive or continue to exist in harsh environments, Experiments are time- and space-intensive. In [4] traditional wake up scheduling nodes have to wake up many times so that energy will be deteriorated soon. So that authors have proposed polynomial-time algorithm, so that nodes wake up only for optimum number of time. Due to this hidden terminal problem is avoided. In [5] authors, have proposed Mobile Elements (MEs) have been proposed as mechanical carriers of data to prolong the sensor network lifetime and to partitioning problem is overcome by the network. A scheduling approach is proposed, periodically generated data collected by the MEs, also called Regular Messages (RMs), from nearby sensor nodes with no buffer overflow.

Proposed System: Sensor networks are highly distributed networks of tiny, light weight Nodes banish in large numbers to monitor the atmosphere or system by the measurement of physical parameters such as temperature, pressure, or relative humidity. A sensor node should be tiny in size, consume low energy, operate in high volumetric densities, be autonomous and operate forsaken and be adaptive to the environment. As wireless sensor nodes are typically very tiny electronic devices, they have limited power source of less than 1.2- 3.7 volts. In some applications the sensor nodes are placed in the hard to reach places changing the battery frequently is costly and inconvenient too Regularly we can't change the battery. The two major forms of sensor network architecture are layered and clustered. Clustered architecture is especially useful for sensor networks the main advantage of clustered architecture is data fusion [6]. The cluster head fuse all the data gathered by members of the cluster and resulting information needs to be communicated to the BS. Cluster head election and cluster formation is distributed process. This is achieved through Hybrid Energy Efficient distributed protocol (HEED).

PROPOSED SYSTEM FLOW CHART

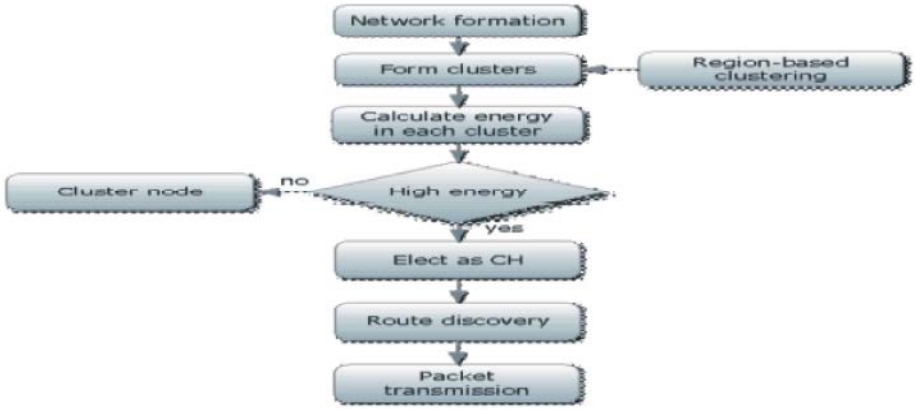

Fig. 2: Flow chart

Cluster Formation: A region based clustering is the process of clustering the geographical are into set of clusters depends upon the area restriction. Benefit of this region based clustering is easy computation.To find homogeneous regions as much as possible, it uses a multi-resolution grid structure, which quantizes the domain spaceinto a finite number of cells [7]. The X and Y axes are partitioned separately and then, by crossing the partitions of the X and Y axes cells are generated. After quantization, each region (i.e., cell) is examined to determine if it is homogeneous. Solve the uneven energy consumption of nodes by Region based clustering, for WSN is non-uniformly distributed network.

Cluster Head Election: Hybrid Energy-Efficient Distributed (HEED) is a popular energy-efficient protocol for Clustering. HEED is a distributed clustering method. Within each cluster A single-hop communication pattern

is retained ; whereas base station (BS) allow multi-hop communication among the cluster heads (CH). CHs are selected Based on the residual energy and intra cluster communication cost. Initial set of CHs are selected probabilistically based on the each node Residual energy. In HEED the CHs are selected based on the residual energy not randomly. Only the sensors which having high residual energy is elected as CH, energy of the all the nodes are not uniform it will be varying depend upon the communication. Nodes within the cluster are communicated with its CH directly. HEED is distributed network and it has the lowest intra cluster communication cost.

Each sensor sets its probability of becoming a CH. CH_prob, as follows::

$$CH_{prob}=C_{prob} * E_{residual} / E_{max} \quad (1)$$

$E_{residual}$ Where is the current energy in the sensor and E_{max} is the initial energy.CH_{prob} is not allowed to fall below a certain threshold P_{min}, which is selected to be inversely proportional to E_{max}. The main body of the algorithm consists of a (constant) number of iterations. Every sensor goes through these iterations until it finds the CH that it can transmit to with the least transmission power (cost).When the probability less than one it will become tentative cluster head. if it is reached 1 then it will permanently become as cluster head. If it hear any announcement related to change in status of CH then it will change the cluster head, if it doesn't hear any announcement then same CH will maintain it process as CH.

Cluster Based Routing Protocol (CBRP): Routing discovery is achieved using CBRP. It used to send the data packet from the source to the destination using routing discovery. The routing request (RREQ) sends to the all nodes along with its own ID [8]. This request is always send only once not more than one. RREQ follow the pattern to reach the destination to transmit the data,

S,CH1,G1,CH2,G2,G3,CH3..... D (2)

The destination send the routing reply to source node after receiving the RREQ. The sequence of order will be load in that recorded route.

CBRP has the following features:

- Less flooding traffic is happen during the dynamic route discovery process
- Fully distributed operation.

Performance Evaluation

Simulation Setup

SIMULATOR	NETWORK SIMULATOR 2
NUMBER OF NODES	100
TOPOLOGY	Random
INTERFACE TYPE	Phy/ WirelessPhy
MAC TYPE	802.11
QUEUE TYPE	Drop tail/Priority Queue
ANTENNA TYPE	Omni antenna
ROUTING PROTOCOL	CBRP
PROPAGATION TYPE	Two ray Ground
TRANSPORT AGENT	UDP
APPLICATION AGENT	CBR
IDLE POWER	0.0 watts
INITIAL ENERGY	500 Joules
SIMULATION TIME	50 seconds

RESULTS AND DISCUSSION

First compare our propsed sytem with respect to their average life time improvemant ratio. The network lifetime is calculated by using the formula,

Lifetime improvement ratio (R_A(I)) = *min* L (A, I)/L(I) (3)

For any node rotation algorithm A and input instance I, let L (A, I) denote the lifetime achieved using algorithm A on I, L(I) the lifetime without node rotation, R_A (I) lifetime improvement ratio (LIR) of A on I.

We observe that life time improvement ratio of existing system life time is decreasing when increasing the round length.Compare to existing system lifetime improvement ratio is increasing in proposed system. In both cases, we see that the average improvement ratios of our algorithms increase as the total number of rounds and relocations in the network increase.

Throughput is number of successfully received packet at the destination.

$$\text{Throughput} = \sum_i^n \frac{recv\_size}{(stop\ time - start\ time)} \quad (4)$$

Where,

Recv_size- receiving size of each packet.

Start_time-the time when the nodes start to transmit

Stop_time-the time when the nodes stop to transmit

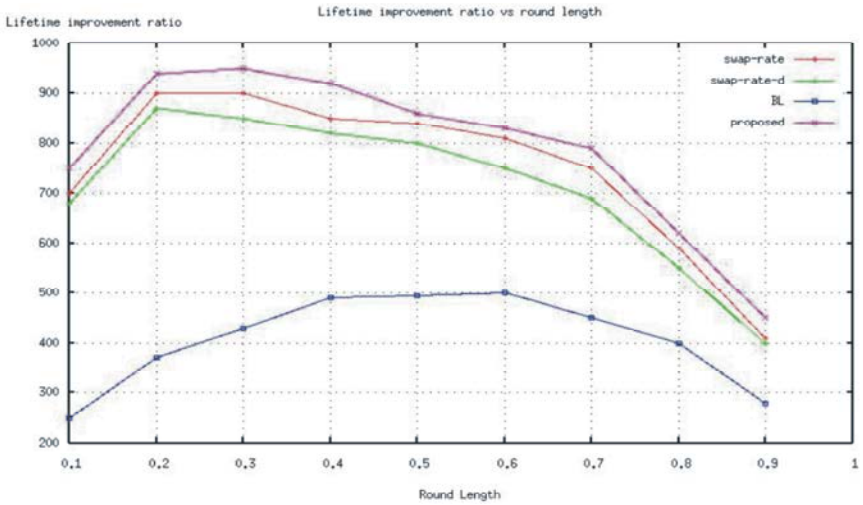

Fig. 3: Lifetime improvement ratio vs round length

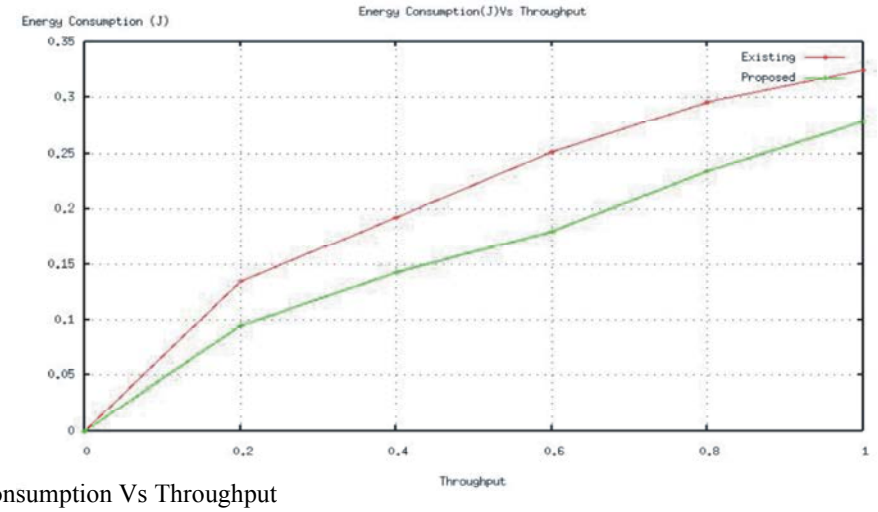

Fig. 4: Energy consumption Vs Throughput

Energy consumption is nothing but overall energy consumed for transmission.

$$CE = (\sum_{i}^{n} Initial\_Energy - Final\_Energy\ [i]\ )^{n} \quad (5)$$

Where,
CE - Consumed Energy
I - Initially is 0
n - Number of nodes

Final energy is also called remaining energy. The energy level of nodes in the network represents the energy model. the level of energy of the node has at the beginning of the simulation name as initial value. The initial Energy value is passed as an input value to all the nodes. A node consumes energy for each transmission and receiving of packets. so that the energy of the nodes gets decreased. The energy consumed by the node is calculated by difference between the initial energy value and current energy value.If the energy of the node gets zero then the node gets deactivated. Trace file will store the energy consumption of all the nodes

From the graph we can understand that energy consumption for existing increasing with throughput but in proposed system energy consumption is reduced. For example for throughput 0.6 energy consumption in existing system is 0.25 J but in proposed system 0.17 J only.

The hop distance strategy in WSNs has a major impact on energy consumption of each sensor mote. Multi-hop routing is more energy efficient than direct transmission to the sink and the conditions for which the two-hop strategy is optimal. Here we compare the existing

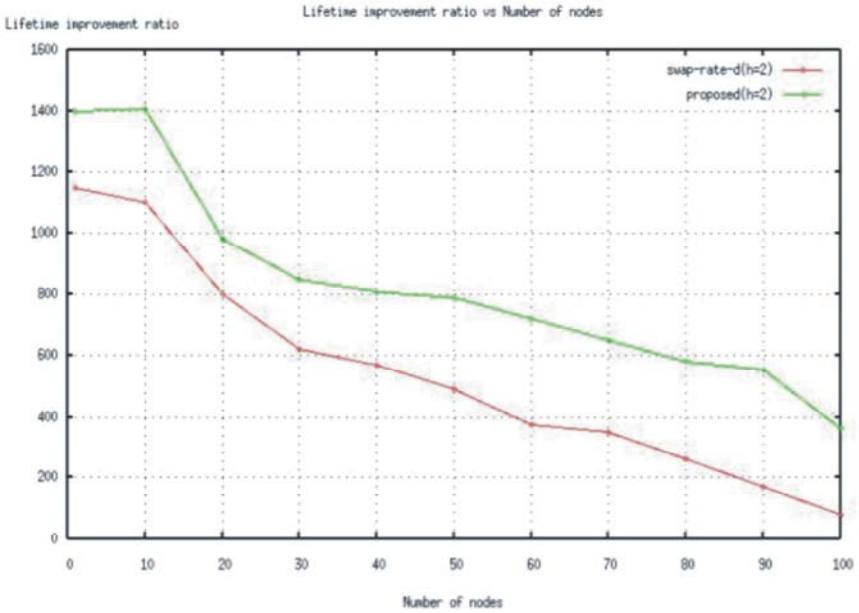

Fig. 5: Life time improvement ratio Vs number of nodes

swap rate-d and proposed system for hop 2. Fig 5 shows that proposed system lifetime is improved then existing for hop 2.

Difference between the number of generated packet and received packets is named as Packet loss in a communication. awk script is used to calculate Packet Loss which processes the trace file and produces the result.

Packet Drop = Generated Packets – Received Packets (6)

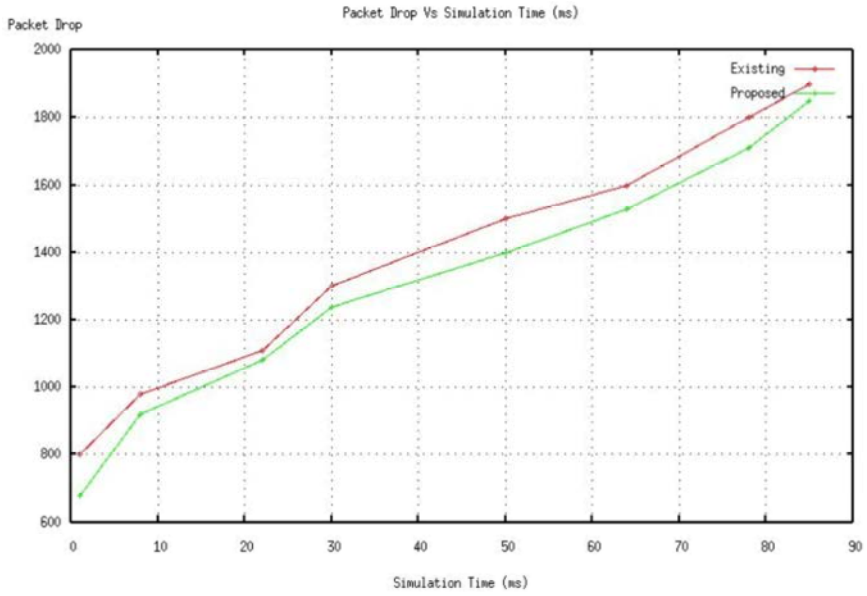

Fig. 6: Packet drop Vs Simulation Time

Packet drop in existing system 1400 in simulation time 40 ns where in proposed system it is 1300.packet dropping is reduced in proposed system.

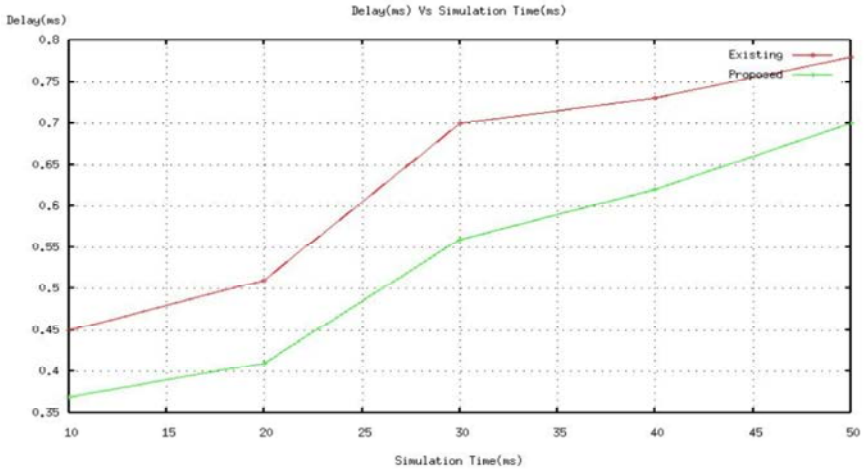

Fig. 7: Delay Vs Simulation time

Delay is calculated using awk script which processes the trace file and produces the result.

$$Delay[i] = \sum_i^n (rt[i] - st[i]) \quad (7)$$

Where,

Delay [i] - denotes that the delay for each and every node which is transmit the data packet information from source to destination.

rt [i] - Stop time

st[i] - Start time

CONCLUSION

The cluster head rotation is not random process it is completely depends upon the residual energy. This cluster rotation process is continued until least one cluster head is fall below the threshold value. Due to this process communication cost will be less. The experiment result shows that node rotation will increase the network life time. As future work i intend to do that ant colony optimization. ant colony optimization is the process of finding the optimum path for transmitting the data from source to the destination.

REFERENCES

1. Chuan Lin, Yanxiang He and Naixue Xiong, 2006. "An Energy-Efficient Dynamic Power Management in Wireless Sensor Networks", publisher: IEEE Computer Society.
2. El-Moukaddem, F., E. Torng, G. Xing and S. Kulkarni, 2009. "Mobile relay configuration in data-intensive wireless sensor networks," in IEEE MASS, pp: 80-89.
3. Holger Karl, Andreas Willig (June 27, 2005), "Protocols and Architectures for Wireless Sensor Networks", Publisher: Wiley; 1 edition.
4. Keshavarzian, A., H. Lee and L. Venkatraman, 2006. "Wakeup scheduling in wireless sensor networks," in MobiHoc, pp: 322-333.
5. Somasundara, A.A, A. Ramamoorthy and M.B. Srivastava, 2007. "Mobile element scheduling with dynamic deadlines," IEEE Transactions on Mobile Computing, 6(4): 395-410.
6. Holger Karl, Andreas Willig (June 27, 2005), "Protocols and Architectures for Wireless Sensor Networks", Publisher: Wiley; 1 edition.
7. Suzuki, M., S. Saruwatari, N. Kurata and H. Morikawa, 2007. "A high-density earthquake monitoring system using wireless sensor networks," in Proceedings of the 5th international conference on Embedded networked sensor systems, ser. Sen Sys'07, pp: 373-374.
8. Sha, M., G. Xing, G. Zhou, S. Liu and X. Wang, 2009. "C-mac: Model driven concurrent medium access control for wireless sensor networks," in INFOCOM, pp: 1845-1853.