Advances in Computer Science and Information Technology (ACSIT)
p-ISSN: 2393-9907; e-ISSN: 2393-9915; Volume 2, Number 12; July-September, 2015 pp. 15-20

http://www.krishisanskriti.org/acsit.html

Enhanced Tabu Search Based Hybrid Routing Protocols for Wireless Sensor Networks

Jaspreet Kaur[1] and R C Gangwar[2]

[1]M.Tech CSE Student, Punjab Technical University, Jalandhar (Punjab), India
[2]Department of CSE BCET Gurdaspur(Punjab.), India
E-mail: [1]jaspreetwarraich@gmail.com, [2]rcg65dec@iitr.ernet.in

Abstract—*The research of wireless sensor networks is demanding in so it takes a vast extent of knowledge. Data aggregation at the bottom station with entity nodes is the beginning of overflow of the info which consequences in utmost power utilization. To overcome this trouble a fresh data aggregation technique has been planned called ERA which gives better consequences for the available WSNs protocols using the collection based data aggregation but still it has shown some drawbacks. The review shows that the all of the existing techniques has neglected the use of the (1) The effects of the mobile sink in the all of the energy efficient protocols has been ignored. (2) The affectation of lossless data compression has been neglected by the all of the researchers. (3) No optimization technique is known as for the effective route selection in ERA protocol. To diminish such drawbacks a new proposed technique has been proposed in this paper. Standard enhancement has been done using the TABU search based optimization method for energy efficient routing algorithm. Furthermore the usage of the compressive sensing also advances the performance more. The compressive sensing uses data union to get rid of unneeded data from sensor nodes, so improves the consequences further. The proposed technique is designed and implemented in the MATLAB tool. Two metrics i.e. First node dead time and half node dead time are also be used to evaluate the improvement of the proposed technique over ERA.*

Keywords*: Era, tabu search, energy efficiency, data aggregation.*

1. INTRODUCTION

Wireless Sensor Network contains large quantity of low power, low cost, light weight small sensor nodes deployed in a field or very close to the physical phenomenon to detect the events like temperature, pressure, movement etc. A warning node contains sensing unit, processing unit, communication unit and power unit. Each sensor node sense the event, process it and communicate it with the other nodes or Base Station through high frequency channel using single hop or multi-hop communication. Sensor nodes are supplied with small batteries having limited energy, which limits the time of the Sensor network. To increase the time of the sensor network with limited electric batteries is the main challenge. [11]

The paper's remaining part is structured as given: Clustering in wireless sensor network explained in part II. Part III describes ERA. Part IV identifies compressive sensing. Part V gives literature review. PART VI gives research methodology. Experimental setup specified in part VII. PART VIII shows experimental results. PART IX identifies analysis of results. PART X shows performance evaluation table. Finally Part XI presents conclusion and future scope.

2. CLUSTERING IN WSN

Clustering is one of the major tasks in wireless sensor network for energy efficiency and network stability. In wireless sensor network, the clustering which is processed through the central processing unit is known to be well and also in use for a long period of time. Now a day's clustering is done through the distributed methods in order to overcome the troubles like network life span and energy. This process of clustering deals with the grouping of identical objects. Cluster is formed by the group of nodes in which local interactions between the members of cluster are handled by the cluster head. Cluster members aggregate the collected data and then send this data to cluster head for the sake of conserving energy. In other words we can say that clustering is done to relate the identical sensor nodes and conserves energy that is wasted in direct data transmission to base station. Consequently, clustering has shown most important metric for evaluating the performance of wireless sensor network. Besides achieving energy efficiency clustering diminishes the channel contention and resulting in better throughput under the heavy load. [12-13]

3. ENERGY AWARE ROUTING ALGORITHM FOR WIRELESS SENSOR NETWORKS

This work has focused on a brand new energy-aware routing algorithm, called ERA for a group based wireless sensor network that addresses the aforementioned issues. In our approach, most of the sensor nodes are organized into distinct clusters. To choose CHs, each node starts the operation to become a CH by initiating a time wait which depends upon its remaining energy. To make clusters, nodes join CHs by considering their residual energy and distance.

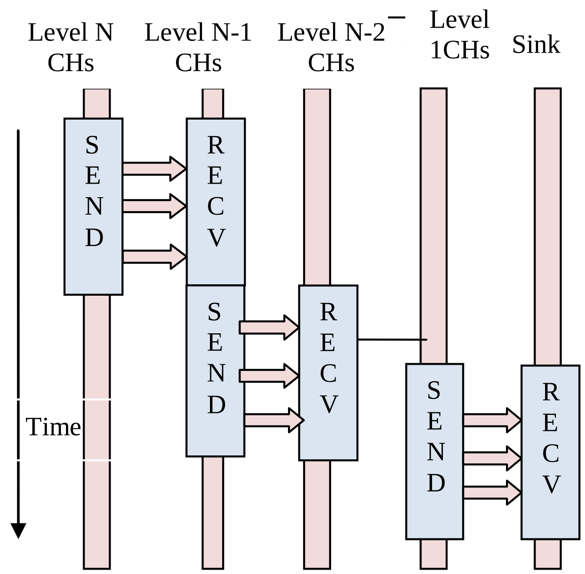

Fig. 1: Sequence diagram for data sending and receiving schedules of the CHs in the DVB.

Then, a directed virtual backbone (DVB) of CHs fixed at the sink is constructed using most of the CHs to facilitate the routing of the data. In data routing, each CH forwards the info packets to next hop CHs such way that their energy consumption may be balanced. Experiments are performed on planned algorithm, ERA. Comparisons based on consequences have been made with presented routing algorithms such as for example Energy-Efficient and Power-Aware and Energy-Aware Distributed Clustering and also with this previous works such as for example Back Off-Based Distributed Clustering Protocol and Energy-Aware Multi-Level Routing Algorithm. The outcomes demonstrate the potency of the proposed algorithm with regards to network life time, energy consumption, power imbalance factor, and data aggregation. [1]

4. COMPRESSIVE SENSING

Compressive sensing is really a fresh technique utilized for energy efficient data gathering in wireless sensor networks. It is characterized by its easy encoding and difficult decoding. The power of compressive sensing is its control to recreate sparse or compressible signals from tiny amount of dimensions without requiring any a priori details about the signal formation. Considering the fact wireless sensor nodes tend to be deployed thickly, the association among them can be utilized for extra compression. [14]

5. LITERATURE REVIEW

T.Amgoth et al. [1] projected energy aware routing algorithm for wireless sensor network. This algorithm was mainly focused on cluster head selection process, left over energy of the CHs and the intra-cluster space for the formation of cluster. The brand new results revealed that the algorithm outperforms other existing algorithms when it comes to network life time, energy utilization and other parameters. L.Mahajan et al. [2] proposed a brand new self-motivated plan for electing the perfect CH in Stable Election Protocol. Comparisons of planned algorithm with presented algorithm are better with respect to packets provided for CHs, when network life span dead. V. Hoang et al. [3] presented a story CH election plan to give network life span and consistency by taking obstacle-aware criteria into consideration.J.Yadav et al. [4] centered on analytical categorization of numerous proposed Cluster Head selection schemes. New parameters like awareness and accessibility of node could be taken into account to elect single CH and to improve stability. L. Bhasker et al. [5] wished-for a cluster-based data aggregation in wsn. Consequences showed that the planned system decreased the energy utilization, ensured facts protection and compact the broadcast operating cost. P. Ghaffariyan et al. [6] investigated the usefulness of data aggregation. After that they pretend two aggregation methods of Differential and Integrated Data compression which showed vital improvements to enhance network life span. A.Ruperee et al. [7] planned technique compact packet size by processing the information at the node itself using Delta Modulation. With slight energy utilization, the duration of the network could be enlarged. Nitesh et al. [8] presented an algorithm for relay node placement for wireless sensor networks resulting into an absolutely covered and connected network. AV.Karthick et al. [9] proposed A Multi Queue Scheduling algorithm to reduce the expense of both reservation and on-demand plans utilizing the global scheduler. This method had increased the satisfaction of an individual and utilized the free unused space of resources for increased performance. A .Jeong et al. [10] planned the latest cluster based routing protocol, MPDA not just escalates the exactness of dimension however in addition provides energy efficiently in wsn. As a result, MPDA surpasses LEACH with regards to a pair of errors and energy utilization.

6. RESEARCH METHODOLOGY

The planned technique has the ability to overcome the limitations of the existing ERA routing protocol by using compressive sensing based TSERA. The proposed technique is designed and implemented in the MATLAB tool. The current research work is planned to make the comparison between ERA, and proposed compressive sensing based TSERA based on the parameters such as: a) First node dead time

b) Half node dead time

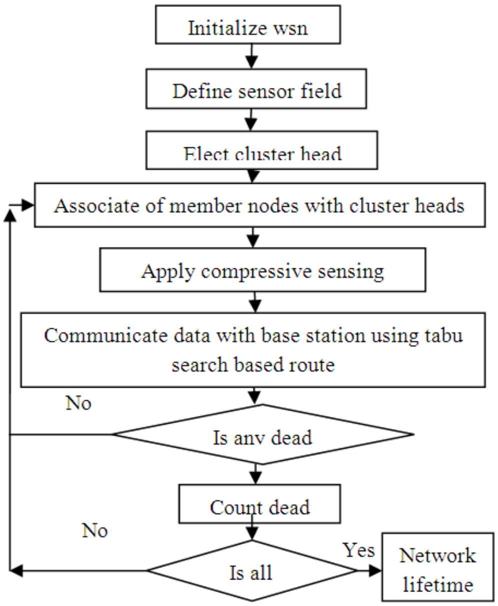

Fig. 2: Flowchart of the Proposed Technique.

Step 1:- Initialize the wireless sensor network with the various characteristics.
Step 2:- Define sensor field with the respective placement of the sensor nodes and also the base station.
Step 3:- Now cluster head selection technique come in action to elect some of the sensor nodes as cluster heads.

$$T(s) = \begin{cases} \dfrac{P_{opt}}{1 - P_{opt}\left(r.\mathrm{mod}.\dfrac{1}{P_{opt}}\right)}, \text{if } S \in G' \\ 0 \text{ Otherwise} \end{cases}$$

Now association of the member nodes with the cluster heads will be done by using the minimum distance formula between the member nodes and the respective cluster heads.

$$d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

Apply compressive sensing technique to fuse data from the cluster heads and compress it before sending to the base station.

$x^{(k)} = \varphi s^{(k)}$

$y^{(k)} = \emptyset\, x^{(k)}$

Now, using (3) and (4) we can write

$$y^{(k)} = \emptyset\, x^{(k)} = \emptyset\, \varphi\, s^{(k)} \overset{def}{=} \tilde{\varphi}\, s^{(k)}$$

Step 6:- Now evaluate the route using the TABU search and communicate the data from the cluster head(s) to the base station.

Input: TL_{size}

Output: FS_{best}

$FS_{best} \leftarrow CIS()$

$TL \leftarrow \emptyset$

While (¬ SC())

$C_{list} \leftarrow \emptyset$

For ($FS_C \in FSbest_N$)

If (¬CAF (FS_C , TL))

$C_{list} \leftarrow FS_C$

End

End

$FS_C \leftarrow LBC(C_{list})$

If($Cost(FS_C) \leq Cost(FS_{best})$)

$FS_{best} \leftarrow FS_C$

$TL \leftarrow FD(FS_C, FS_{best})$

While($TL > TL_{size}$)

DF(TL)

End

End

End

Return (FS_{best})

Where FS is Final solution

C is Candidate

TL is Tabu List

FD is Feature Differences

CIS is ConstructInitialSolution

SC is Stop Condition

CAF is Contain Any Features

LBC is Locate Best Candidate

DF is Delete Feature

N is Neighborhood

Step 7:-Evaluate the energy dissipation and update the remaining energies it. Where distance will be evaluated and updating of energy will be based upon the following given equations.

$d_{toCH} = \frac{M}{\sqrt{2\pi k}}, d_{toBS} = 0.765\frac{M}{2}.$

$E_{Tx}(1, d) = 1E_{elec} + 1\epsilon_{fs}d^2, d < d_0$

$E_{Tx}(1, d) = 1E_{elec} + 1\epsilon_{mp}d^4, d \geq d_0$

$$\text{Where } d_0 = \sqrt{\frac{E_{fs}}{E_{mp}}}$$

M represents the area of wsn

E_{fs} represents the amplification energy of free space

E_{mp} represent the amplification energy when more area

Step 8:-Count if any dead node and check whether all dead. If all dead the show network lifetime and return else move to step 3

$$\text{Dead} = \begin{cases} 1 \; if \; S(i)Energy \leq 0 \\ 0 \; Otherwise \end{cases}$$

$$\text{Termination} = \begin{cases} 1 \; if \; countdead == n \\ 0 \; Otherwise \end{cases}$$

7. EXPERIMENTAL SETUP

In order to implement the proposed algorithm, design and implementation has been done. Table 1 has shown various constants and variables required to simulate this work. These parameters are standard values used as benchmark for WSNs.

Table 1: Experimental Setup

Parameter	Value
Region(x,y)	100,100
BS (x,y)	100,100
N	100
P	0.1
Eo	0.5
transmiter_energy	50nJ/bit
receiver_energy	50nJ/bit
Free space(amplifier)	10nj/bit/m2
Multipath(amplifier)	0.0013pJ/bit/m4
a	1
Maximum lifetime	4000
Message size	4000 bits
m (fraction of advanced nodes)	0.1
Effective Data aggregation	5nJ/bit/signal

8. EXPERIMENT RESULTS

The experimental results show that the planned protocol CSTERA performs superior than the existing protocols. All the figures given below having the dimension area of 100*100.Nodes represent by white and blue diamonds are sensor nodes and cluster heads respectively. Blue and Magenta line gives cluster range and shortest path between cluster head and base station in sensor network correspondingly. Green diamond is the relay node that communicates directly to the base station. Fig. 3 shows active nodes represented by white diamond. Fig. 4 and 5 demonstrates first, half dead node represent by Magenta-blue star respectively. The entire network has base station that is responsible for the collection of data from all other nodes.

8.1 WSN in Active Stage

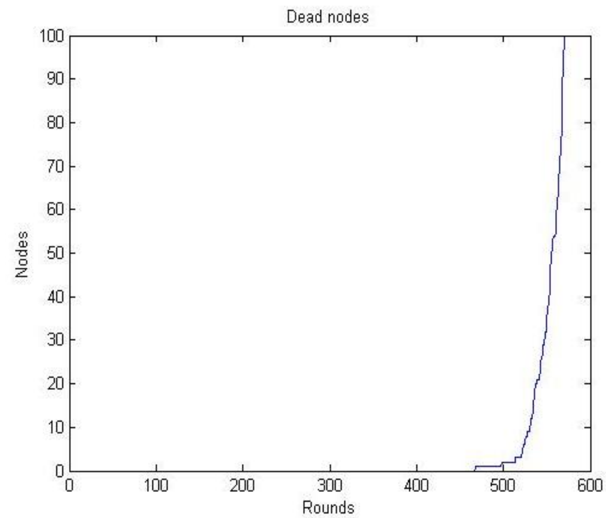

Fig. 3: Initial configuration of WSN

8.2 First Dead node

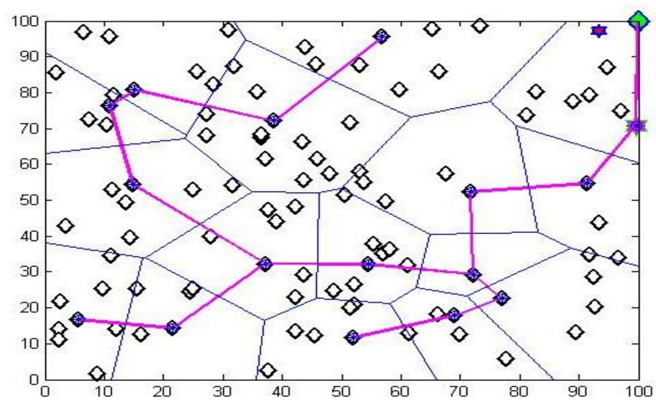

Fig. 4: First Dead Node

8.3 Half Dead node

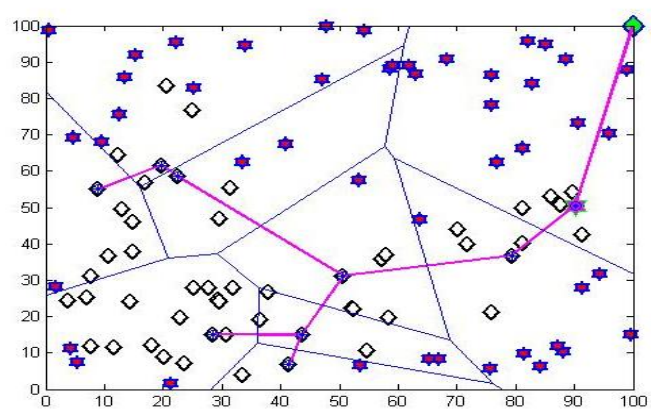

Fig. 5: Half Dead Nodes

9. ANALYSIS OF RESULT

From our Analysis we realize that the CSTERA protocol performs better than existing protocol. The results of CSTERA for Wireless sensor network are shown below in following graphs. Fig.6 and 7 shows that the statistics of alive node, dead nodes with different number of rounds in CSTERA. Here in both figures x-axis represents number of rounds and y-axis represents number of nodes. Fig.8 and 9 shows total number of packet sent to BS, CH and in this x-axis represent number of rounds and y-axis represents number of packets. Fig.10 shows remaining energy. X-axis represents the rounds. Y-axis represents the energy.

9.1 Alive Nodes.

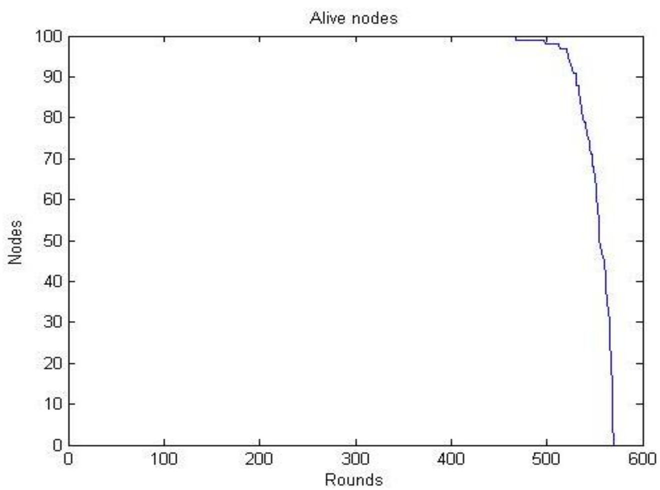

Fig. 6: Alive Nodes versus number of rounds

9.2 Dead Nodes

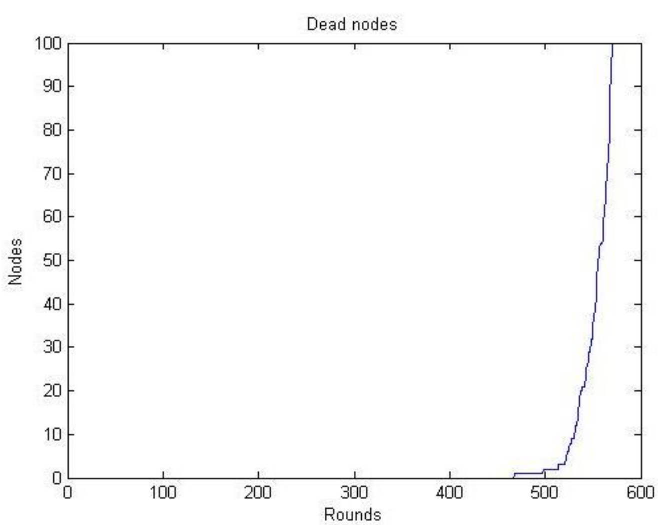

Fig. 7: Dead Nodes versus number of rounds

9.3 Packets Sent To Base Station

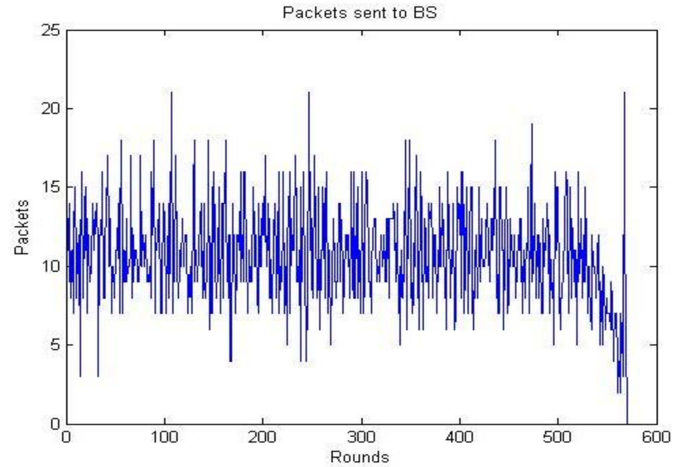

Fig. 8: Packets sent to BS versus number of rounds

9.4 Packet sent to Cluster Head

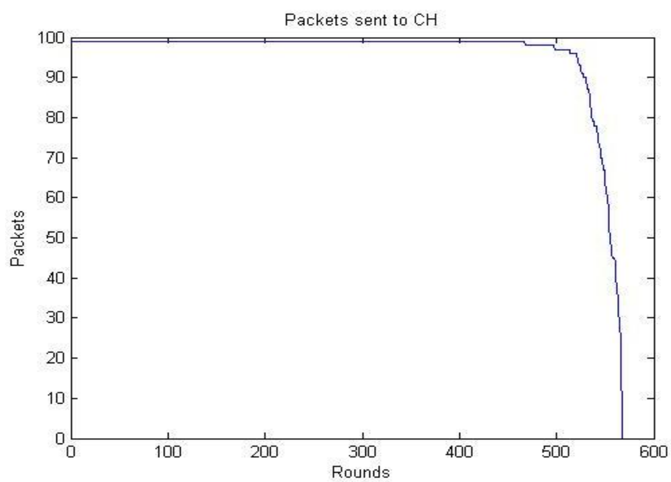

Fig. 9: Packet sent to CH versus number of rounds

9.5 Remaining Energy

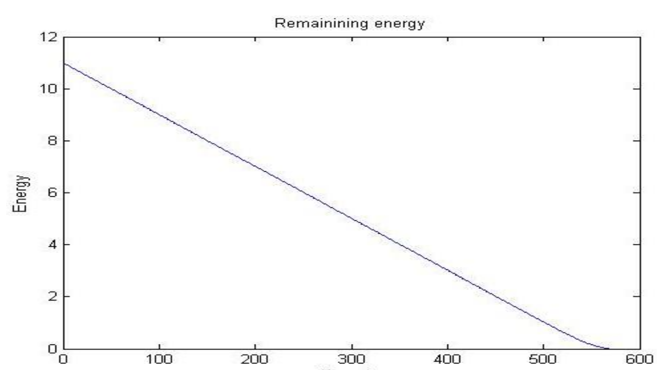

Fig. 10: Remaining Energy

10. PERFORMANCE EVALUATION TABLE

The tables 2 and 3 depict the comparison between the existing and proposed protocol. In the case of proposed protocol CSTERA have numbers of rounds for first node dead and half node dead are more than the existing protocols TERA and ERA.

10.1 First Dead Node

Table 2: First Dead Node

Energy	CSTERA	TERA	ERA_B
0.11	517	205	195
0.12	562	229	215
0.13	607	240	234
le0.14	655	252	251
0.15	704	281	266
0.16	750	310	287
0.17	796	331	306
0.18	843	354	325
0.19	888	361	350
0.20	935	386	366

10.2 Half Dead Node

Table 3: Half Dead Node

Energy	CSTERA	TERA	ERA_B
0.11	560	257	247
0.12	610	280	269
0.13	661	306	293
0.14	711	328	312
0.15	762	352	336
0.16	813	373	358
0.17	864	397	377
0.18	914	418	400
0.19	965	446	421
0.20	1015	471	451

11. CONCLUSION AND FUTURE WORK

To prolong the network life span with limited electric batteries is the main challenge in the improvement of wireless sensor networks. The proposed technique has the ability to overcome the drawbacks of the ERA routing protocol by using compressive sensing and TABU search based optimization technique for energy efficient routing algorithm. Two metrics are also be used to evaluate the improvement of the proposed technique over ERA. The comparisons has clearly revealed that the number of rounds for first node dead and half node dead are more in proposed technique as compared to available ERA. Thus network life time is greater in case of new proposed protocol. This work has considers only two parameters for comparison between ERA, and proposed compressive sensing based TSERA. Further we will use some other parameters to evaluate performance of proposed technique as compared to existing one.

REFERENCES

[1] T. Amgoth, and P. K. Jana"Energy-aware routing algorithm for wireless sensor networks." Computers & Electrical Engineering, 2014.

[2] L. Mahajan, and N. Sharma. "Improving the stable period of WSN using dynamic Stable leach Election Protocol." in *IEEE* International Conference on Issues and Challenges in Intelligent Computing Techniques (ICICT), 2014, pp. 393-400, 2014.

[3] V.Hoang, N. Julien, and P. Berruet. "Cluster-Head Selection Algorithm to Enhance Energy-Efficiency and Reliability of Wireless Sensor Networks." in proceeding of 20th European Wireless (EW) Conference. 2014.

[4] J. Yadav, and S.K. Dubey. "Analytical study of Cluster Head selection schemes in Wireless Sensor Networks." in International Conference on Signal Propagation and Computer Technology (ICSPCT), pp. 81-85, 2014.

[5] L. Bhasker. "Genetically derived secure cluster-based data aggregation in wireless sensor networks." IET Information Security, Vol. 8, No. 1, pp 1-7, 2014.

[6] P. Ghaffariyan. "An effective data aggregation mechanism for wireless sensor networks." in 6th IEEE International Conference on Wireless Communications Networking and Mobile Computing (WiCOM), pp. 1-4, 2010.

[7] A. Ruperee, S. Nema, and S. Pawar. "Achieving energy efficiency and increasing network life in wireless sensor network." in IEEE International Advance Computing Conference (IACC), pp. 171-175, 2014.

[8] K. Nitesh, and P. K. Jana. "Relay node placement algorithm in wireless sensor network." in IEEE International Advance Computing Conference (IACC), pp. 220-225, 2014.

[9] A.V. Karthick, E. Ramaraj, and R.G. Subramanian. "An Efficient Multi Queue Job Scheduling for Cloud Computing." in World Congress on Computing and Communication Technologies (WCCCT), pp. 164-166, 2014.

[10] A. Jeong, S. Kim, C. Lee, and J. Kim. "Multi-periodic Data Aggregation Scheme Based on Interest for Energy Efficiency in Wireless Sensor Network." In Ubiquitous Intelligence & Computing and 9th IEEE International Conference on Autonomic & Trusted Computing (UIC/ATC), pp. 918-923, 2012.

[11] Akyildiz, Ian F., Weilian Su, Yogesh Sankarasubramaniam, and Erdal Cayirci. "Wireless sensor networks: a survey." Computer networks 38, no. 4 (2002): 393-422.

[12] Sasikumar, P., and Sibaram Khara. "K-means clustering in wireless sensor networks." In Computational intelligence and communication networks (CICN), 2012 fourth international conference on, pp. 140-144. IEEE, 2012.

[13] Abbasi, Ameer Ahmed, and Mohamed Younis. "A survey on clustering algorithms for wireless sensor networks." Computer communications 30, no. 14 (2007): 2826-2841.

[14] *http://www.slideshare.net/prakashmalavalli1/data-compression-in-wireless-sensor-networks*