International Journal of Information & Computation Technology.
ISSN 0974-2239 Volume 4, Number 15 (2014), pp. 1567-1574

http://www. irphouse.com

An Improved Gateway Based Multi Hop Routing Protocol for Wireless Sensor Network

Pallavi Jain[1] and Harminder kaur[2]

Student M.Tech[1], Assistant professor[2]
[1,2] Guru Nanak Dev Engineering College Ludhaiana, Punjab India

Abstract:

In this research paper, we introduced a gateway based energy efficient Multi hop routing protocol for wireless sensor networks (WSNs) which utilizes minimum energy. In this, Base station is located out of the sensing field and numbers of gateway nodes are deployed at the edge of sensing field. These gateway nodes are rechargeable therefore, it reduces cost. It also reduces traffic problem and reduce distance for reliable transmission of data. Simulation results shows that our proposed gateway based protocol is better in terms of network lifetime than traditional protocol like SEP.

Keywords: Wireless Sensor Network, SEP, clustering, gateway, lifetime**.**

Introduction

Wireless sensor network consists of a set of hundreds or thousands of micro sensor nodes that have capability to sense; establish a connection for communication; and computational operations. Clustering is an important concept in WSN. In clustering, number of sensor nodes select a Cluster Head (CH) on the basis of energy, and then cluster the remaining nodes with these heads. Sensor nodes transmit data to CH; the main function of CH is to aggregate data of sensor nodes and transmits it to BS [10]. The sensor nodes which are most important part of WSN works on non- rechargeable batteries that have standard energy. The problem is that their batteries cannot be replaced. Sensor nodes have life as much as batteries. Therefore, to avoid this problem we need to introduce rechargeable gateway nodes which are placed at the edge of sensing field.

Basic Assumptions:

- We deploy the BS far away from the sensing field. Sensor nodes and the BS are stationary after deployment.

- A gateway node is deployed in the same network field at the edge of the network.
- Gateway nodes are stationary after deployment and rechargeable.
- Each sensor node has distinctive identifier (ID).
- Nodes are uniformly distributed in the network

Model of Proposed Protocol

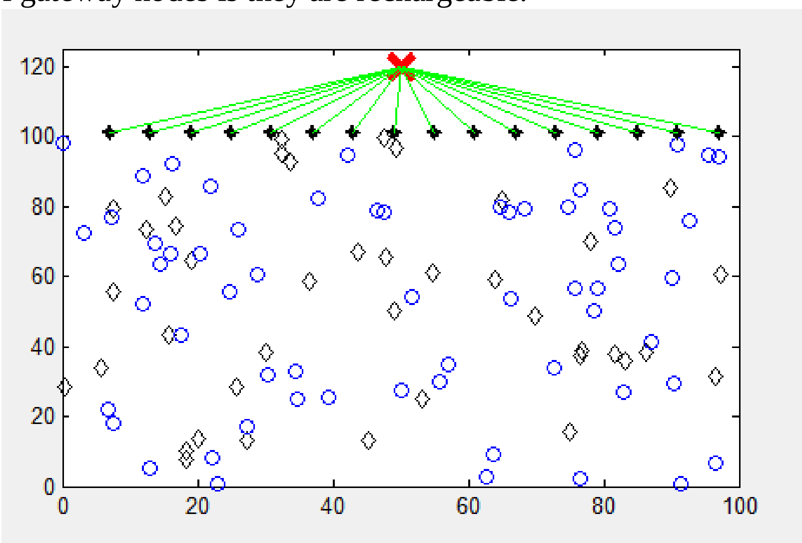
According to the radio energy dissipation model as illustrated in Figure2, in order to achieve an acceptable Signal-to-Noise Ratio (SNR) in transmitting an L−bit message over a distance d, the energy expended by the radio is given by:

$$E_{TX}(l,d) = \begin{cases} L.E_{elec} + L\ \epsilon_{fs}.d^2, & if d \leq d_o \\ L.E_{elec} + L\ \epsilon_{mp}.d^4, & if d > d_o \end{cases} \quad (1)$$

Where, E_{elec} is the energy dissipated per bit to run the transmitter or the receiver circuit, ϵ_{fs} and ϵ_{mp} depends on the transmitter amplifier model, and d is the distance between the sender and the receiver. At d=d_o

$$d_o = \sqrt{\frac{\epsilon_{fs}}{\epsilon_{mp}}} \quad (2)$$

Number of gateway nodes is deployed at the edge of the sensing field. The number of gateway nodes is chosen approximately according to sensor field area. The advantage of gateway nodes is they are rechargeable.



◊	Advanced nodes
○	Normal nodes
×	Base Station
*	Gateway nodes

Fig. 3 Network Model

The sensor nodes are categorized into two types on the basis of their energy level: Normal Nodes, Advanced Nodes. The advanced nodes have more energy factor than the normal nodes.

E_0 is the initial energy of each normal sensor node. The energy of each advanced node is $E_0 (1+\alpha)$. The total energy of the new heterogeneous becomes:

$$E_{total} = nE_0 \, (1 + m\alpha) \quad (3)$$

The weighted probabilities for normal and advanced nodes are chosen to reflect the extra energy introduced into the network system. The probabilities are given below:

$$P_{nrm} = \frac{p_{opt}}{1+m\times\alpha} \quad (4)$$

$$P_{adv} = \frac{p_{opt}}{1+m\times\alpha} \times (1 + \alpha) \quad (5)$$

Where, P_{nrm} is the weighted probability for the normal nodes, and P_{adv} is the weighted probability for the advanced nodes.

Threshold for normal nodes:

$$T_{(s_{nrm})} = \begin{cases} \dfrac{p_{nrm}}{1-\mathrm{p_{nrm}}\left[\mathrm{r} \times \mathrm{mod}\left(\frac{1}{\mathrm{p_{nrm}}}\right)\right]} , & \text{if } n \in g' \\ 0 & \text{otherwise} \end{cases} \quad (6)$$

Where, r is the current round and

G' is the set of nodes that have not become cluster heads within last $1/P_{nrm}$ rounds of epoch.

Similarly, for advanced nodes:

$$T_{(s_{adv})} = \begin{cases} \dfrac{p_{adv}}{1-\mathrm{p_{adv}}\left[\mathrm{r} \times \mathrm{mod}\left(\frac{1}{\mathrm{p_{adv}}}\right)\right]} , & \text{if } n \in g'' \\ 0 & \text{otherwise} \end{cases} \quad (7)$$

Where, G" is the set of nodes that have not become cluster heads within last $1/P_{adv}$ rounds of the epoch.

Simulation Results

We analyze the performance of our proposed protocol with existing SEP.

Simulation Setting

We simulated our proposed protocol using MATLAB. Consider a WSN with nodes randomly distributed in 100*100 fields.

Table 1: Radio Parameters

n	100
E_0	0.5 [J]
Message Size	4000 [bits]
E_{elec}	50 [nJ/bit]
E_{DA}	5 [nJ/bit/signal]
$\in_{fs}$	10 [pJ/bit/m^2]
$\in_{mp}$	0.0013 [pJ/bit/m^4]
No. of Iterations	1600

Stability period (FND):
is the time interval from the start of the network operation until the death of the first node. This is also referred as "stable region" as shown in fig 4

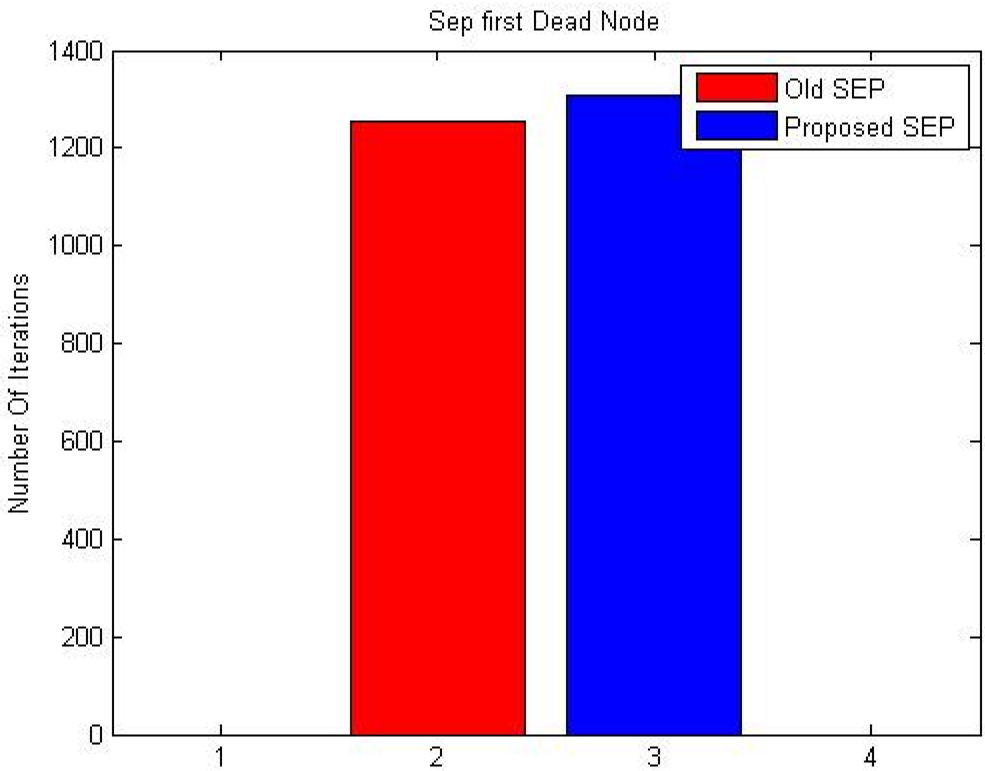


Fig. 4 First Dead Node

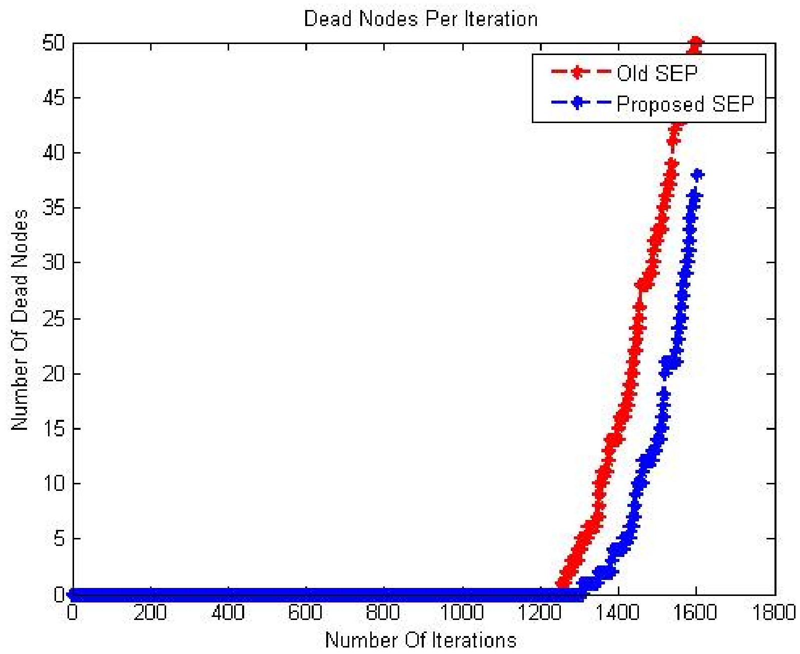


Fig. 5 Number of Dead Nodes

***Number of dead (total and advanced) nodes per iteration*:**
This instantaneous measure the total number of nodes and that of each type that has expended all of their energy as shown in fig. 5, 6.

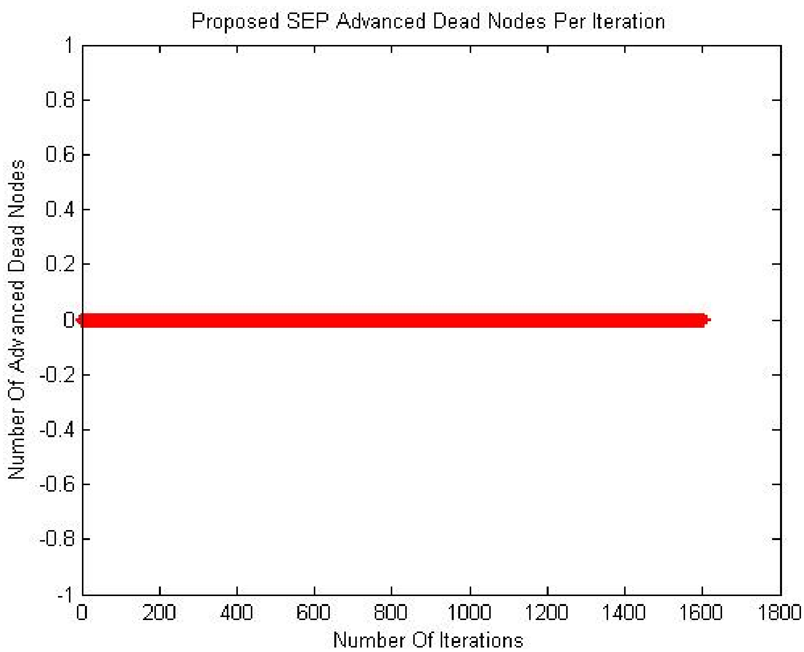


Fig. 6 Number of Advanced Dead Nodes for proposed SEP

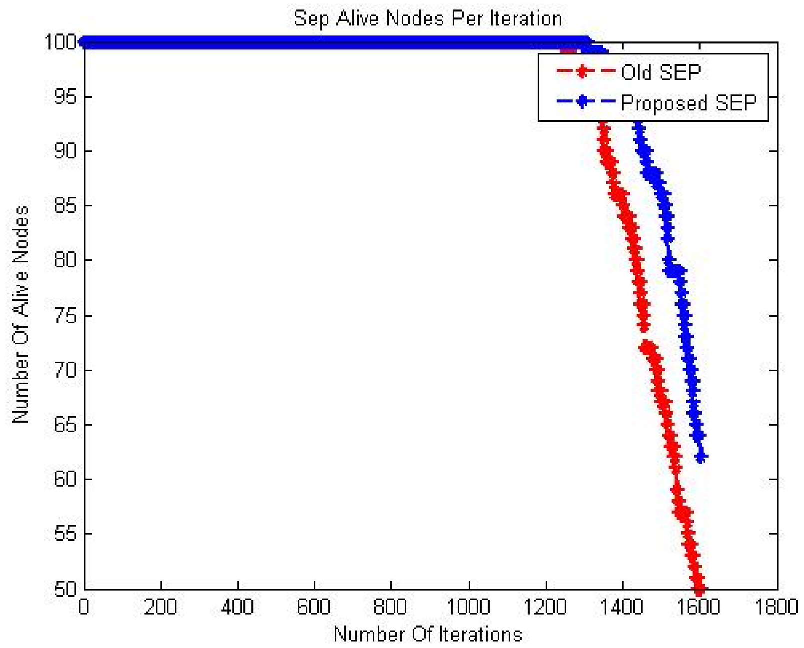


Fig. 7 Number of Alive Nodes

Number of alive (total and advanced) nodes per iteration:

The total number of nodes and that of each type that has not yet expended all of their energy as shown in fig. 7, 8, 9.

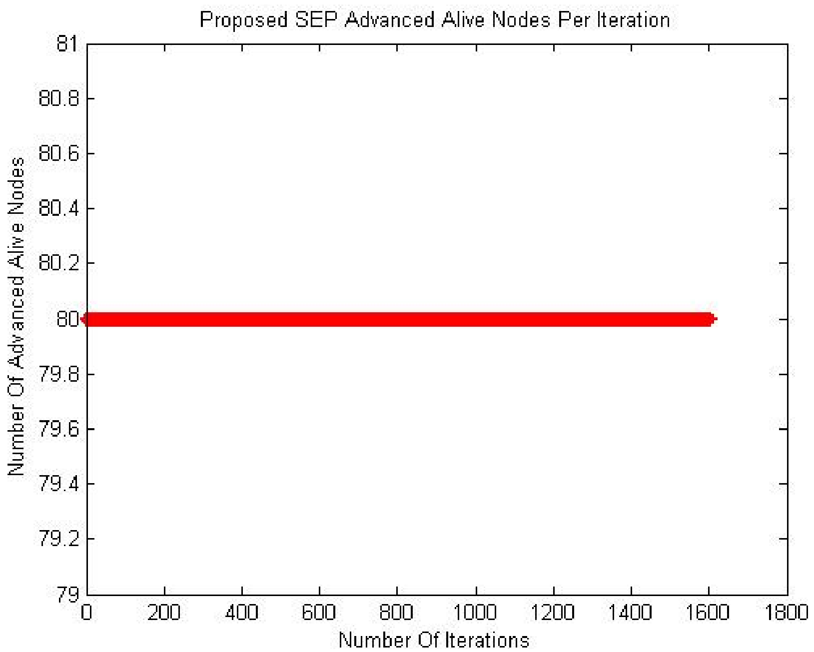


Fig. 8 Number of Advanced Alive Nodes for proposed SEP

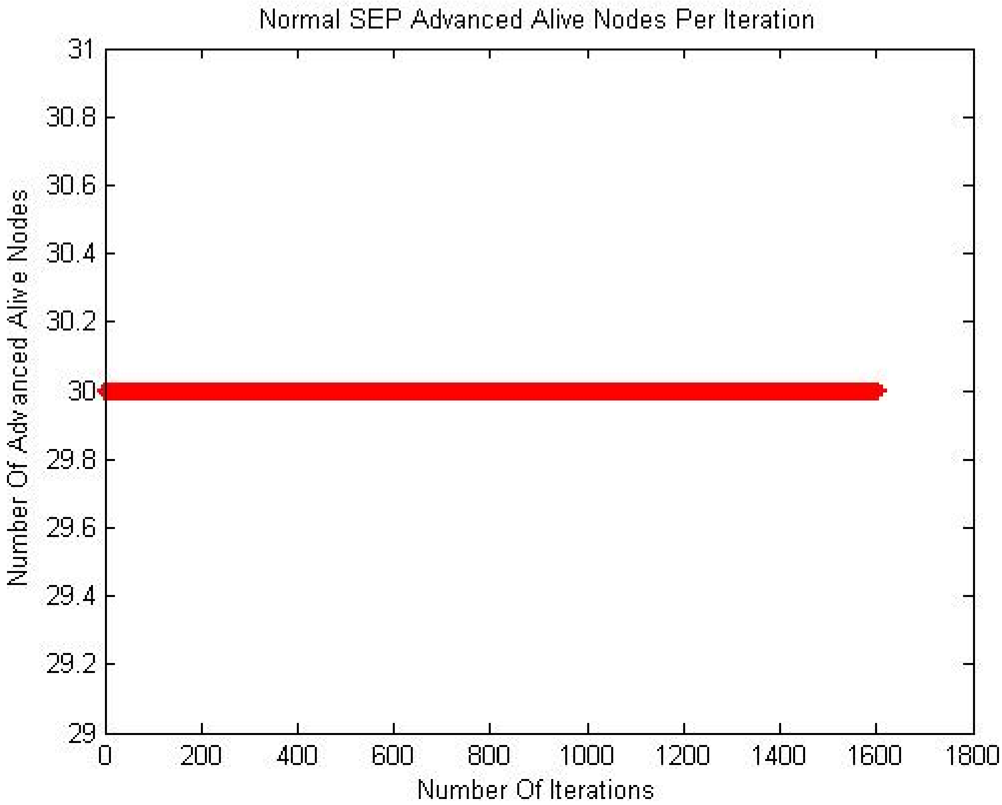


Fig. 9 Number of Advanced Alive Nodes for SEP

Table 2: Simulation Results

Operation	SEP	Proposed Protocol
First Node Dies	1253	1308
Number of Dead Nodes	55	38
Number of Alive Nodes	45	62
Number of Advanced nodes dead	0	0
Number of Advanced Nodes alive	30	80

Conclusion and Future Scope

We design a gateway based network model in order to minimize energy consumption of sensor network. In this research, numbers of gateway nodes are located at the edge of sensing field area. The base station is located away from the sensing field. This technique encourages better transmission of data which further increases lifetime of the network. The main advantage of using gateway nodes is that it reduces distance for transmitting data to base station. Simulation results show that our proposed protocol performs well than existing Stable election Protocol. Other parameters like residual energy and throughput can be calculated and compared with traditional protocols like SEP, LEACH.

REFRENCES

[1] G. Smaragdakis, I. Matta, and A. Bestavros, "SEP: A stable election protocol for clustered heterogeneous wireless sensor networks," *in Proceding of the International Workshop on SANPA*, Boston, USA, 2004, pp. 1–11.

[2] J. Wang, Z. Zhang, J. Shen, F. Xia, and S. Lee, "An Improved Stable Election based *Routing Protocol with Mobile Sink for Wireless Sensor Networks," IEEE International Conference on Green Computing and Communications and IEEE Internet of Things and IEEE Cyber, Physical and Social Computing*, Beijing, China, 2013, pp. 945-950.

[3] Q. Nadeem, M. B. Rasheed, N. Javaid, Z. A. Khan, Y. Maqsood, and A. Din, "M-GEAR: Gateway-Based Energy-Aware Multi-Hop Routing Protocol for WSNs," *Eighth International Conference on Broadband, Wireless Computing, Communication and Applications*, Compiegne, 2013, pp. 164-169.

[4] N. Javaid, Z. A. A. Khan, U. Qasim, "HSEP: Heterogeneity- aware Hierarchical Stable Election Protocol for WSNs," *seventh International Conference on Broadband, Wireless Computing, Communication and Applications*, Victoria, Canada, 2012, pp. 373-378.

[5] A.B. Attea, and A.E. Khalil, "Stable-aware evolutionary routing protocol for wireless sensor networks," *Wireless Pers Communication*, vol. 69, pp. 1799–1817, Dec. 2013.

[6] S. Tyagi, and N. Kumar, "A systematic review on clustering and routing Techniques based upon LEACH Protocol for wireless sensor networks," *Journal of Network and Computer Applications*, vol. 36, pp. 623-645, May 2013.