Asian Journal of Information Technology 15 (21): 4407-4415, 2016
ISSN: 1682-3915

A Poisson-Exponential Energy Factors Based Cluster Head Selection Strategy for Wireless Sensor Network

[1]P.L. Rajarajeswari and [2]N.K. Karthikeyan
[1]Sri Krishna College of Technology, Kovaipudur, 641042 Coimbatore, India
[2]Sri Krishna College of Engineering and Technology, Kuniamuthur, 641042 Coimbatore, India

Abstract: In wireless sensor networks, energy conservation achieved by sensor nodes becomes essential for prolonging the lifetime of the network. Taking this aspect into account, a Poisson-Exponential Energy Factor based Cluster Head Selection Strategy (PEFCHSS) has been proposed for enhancing the performance of the network. Further, selection of efficient cluster heads during data dissemination aggregation is essential for enhancing the lifetime of the network. In this proposed strategy, cluster heads are selected based on Poisson Exponential Energy Factor (PEF) and then cluster formation is initiated. A local clustering mechanism based on Kappa Unification Factor (KUF) is also adopted within a cluster for minimizing communication cost through the trust based cluster formation. The performance analysis of PEFCHSS is carried out based on ns-2 simulator and the proposed approach shows an improvement on an average by 29% over Genetic algorithm inspired Routing Protocol (GROUP) and 22.3% from Fuzzy Ant Colony Optimization Routing (FACOR) in terms of packet delivery ratio, throughput, energy consumption and packet drop rate.

Key words: Clustering methods, energy efficiency, exponential distribution, probability, wireless sensor network.

INTRODUCTION

Wireless Sensor Network (WSN) consists of hundreds or thousands of sensor nodes deployed randomly which gathers data from one environmental area to another through a base station by sensing, processing and transmitting information (Heinzelman *et al*., 2000). The significant issues like unreliable environment, irregular or random deployment of sensor nodes, restricted battery may hurdle the performance and reliability of the sensor network. The important key factor that is highly required in designing a protocol for sensor network is energy optimization factor (Kawadia and Kumar, 2005) as they decide a probabilistic election of cluster head for reliable data dissemination. Sensor networks aids in elucidating the environmental data and aggregating them as required by the target customer for information processing within the time bound using the concept of embedded computing (Akyildiz *et al*., 2002).

The secondary important factor of sensor network lies in the formation of clusters. This clustering of sensor nodes in wireless sensor network represents a temporary grouping of certain number of sensor nodes with data aggregation as the core objective. Hence, it is clear that the energy-consumption of a cluster head node is considerably higher than other sensor nodes. Therefore, the cluster head selection affects the survivability of a network. In this study, we consider the factor of energy consumption to select the cluster head for data dissemination and aggregation.

Literature review: In the literature, the researchers have contributed number of approaches for cluster head selection and criteria imposed for cluster head selection highly impact the behavior of the network in terms of inter communication and intra communication overhead. In (Abbasi and Younis, 2007) different clustering algorithms are compared based on metrics such as convergence rate, cluster stability, cluster overlapping, location-awareness and support for node mobility. The first cluster based routing protocol proposed in the literature is Low-Energy Adaptive Clustering Hierarchy (LEACH) (Heinzelman *et al*., 2002) which selects the cluster head by imposing the threshold criteria. The main objective of this protocol is to reduce energy consumption of cluster head for this it equally distributes the load among the sensor nodes and also cluster heads are rotated within a cluster. In this protocol, cluster head derives data from their

Corresponding Author: P.L. Rajarajeswari, Sri Krishna College of Technology, Kovaipudur, 641042 Coimbatore, India

neighbor sensor nodes present within the cluster and transmit it through base station. A Weighted based on demand distributed Clustering Approach (WCA) is presented by Chatterjee *et al.* (2002). This approach elects cluster head based on node transmission, mobility level and residual of a sensor node. Accordingly, the sensor node with the highest value is chosen as cluster head. Since, WCA mechanism incorporates on demand protocol in which sensor node lodes are evenly distributed, the author incorporates realistic parameters and dynamic properties with flexible weight factors depending upon the applications. An enhanced version of WCA approach known as Improved WCA (IWCA) was presented in which derive additional parameters such as energy consumption of a sensor node and packet transmission rate between each pair of sensor nodes in order to chose more efficient cluster head in heterogeneous type of sensor network. This algorithm is executed in periodic intervals so that the newly included nodes may also be considered which improves the survivability of the network.

Further, Genetic optimization-based clustering protocol proposed by Hussain *et al.* (2007) deals with reduction of energy dissipation, enhancement of system lifetime, resource allocation and bandwidth reusability. Genetic algorithm based technique was presented by Nie *et al.* (2010) which selects the cluster head based on the position and load of deployed sensor nodes. Authors incorporate WCA technique for placing the mobile nodes in the cluster. This technique performs efficiently in the ideal load conditions and loads of the clusters are equally distributed. Based on WCA, another technique known as Optimized Clustering Algorithm (OWCA) was proposed by Babu Prasad. This techniques considered additional parameters such as degree of the node, transmission of a node, mobilization factor of a sensor node, initial level of energy posed, time interval taken by the node between each transmissions and number of hops present between the source and destination nodes for cluster head selection in the sensor network. This algorithm is found to be more effective than the WCA in terms of energy consumption at the same time the complexity involved in the cluster head selection is more. Authors incorporate relationship factors exits between cluster head and routing techniques.

Furthermore, a unified approach for cluster head selection based on genetic approach for two tier wireless sensor networks were in incorporated by Rana and Zaveri (2013). Authors incorporates A-star algorithm for optimal routing in WSN which could able to extend the survivability of the sensor network. The cluster head selection method incorporates performance parameters of the randomly formed sensor network. This approach dynamically forms the transmission path in the network without degrading the performance of the network. Authors also recommend cluster head rotation and other local clustering mechanism in order to perform reliable transmission of the sensed information. In addition to this, a Clustering and In Network Processing Routing Algorithm known as CINPRA was presented by Zhang (2010) in which atomized cluster formation and routing tree construction are incorporated. These techniques reduce the energy consumption to derive a multi-hop routing tree of the sensed data information. In this mechanism, each and every node performs the data aggregation and hence transmission overhead can be reduced. This method dynamically manipulates the transmission which can adapt the topology changes and the cluster head is selected through reduced energy requirements. In addition, an optimal routing protocol called Fuzzy Ant Colony Optimization Routing (FACOR) that uses the concept that is inspired by the foraging behavior of ants is propounded by Amiri *et al.* (2014). This approach tries to find optimal existing paths between the source and base station using ant colony optimization. It combines the behavior of ants with fuzzy logic in order to make the best decision. This approach also uses the principles of the Fuzzy Ant Colony Optimization Routing (FACOR) to develop a suitable problem solution. A genetic algorithm based cluster head selection scheme known as Genetic algorithm inspired Routing Protocol (GROUP) is presented by Chakraborty *et al.* (2011) that ensures sub-optimal energy dissipation of energy dissipation of sensor nodes despite of their random deployment. This approach uses the concept of simulated annealing in spite of greedy algorithm of cluster head selection.

An energy consumption based clustering protocol is discussed in detail by Cheng *et al.* (2012). This protocol is based on the poisson distribution. This method also analyzes the network performance based on the Poisson distribution density of the nodes. Furthermore, sensor nodes with limited energy cannot contribute for data processing as they cannot be co-operative in data collection process independent of the kind of data monitored, collected and gathered (Shu and Wang, 2013). Similarly, Younis and Fahmy (2004) proposed a Hybrid Energy-Efficient Distributed clustering (HEED). This protocol periodically selects cluster heads based on node residual energy and node proximity to its neighbors or node degree. Furthermore, an approach to reduce energy of sensor node during packet transmission based on queue threshold by takingchannel contention into account was discussed by Maheswar and Jayaparvathy (2011). Also, a Pareto Survivor Function based Cluster Head Selection Mechanism (PSFCHSM) was proposed for electing the new cluster head under selfish attack by Rajarajeswari and Karthikeyan (2015). Later, LEACH-Centralized (LEACH-C) was designed which utilizes a centralized algorithm for the selection of cluster head (Geetha *et al*., 2012). The average energy of all the sensor in the network and the node which consumes less amount of energy from the base station is elected as the cluster head for optimal communication link between base station and cluster head. In (Pandey *et al*., 2014) the Virtual Multiple Input Multiple Output (V-MIMO) technique is extended with the scope that the cluster heads and their respective cooperative nodes are formed temporarily that collects the information from them and then the final clustering is done accordingly. In (Ran *et al*., 2010) LEACH protocol performance is improved using Fuzzy Logic (LEACH-FL), where energy level, distance and density of the node are considered in clustering mechanisms. Also in (Francesco *et al*., 2010) a new strategy known as Mobile Data Collectors (MDC) in sparse wireless sensor node is presented. This discovery strategy correctly detects contacts while keeping low energy consumption.

Extracts of the literature: From the survey conducted it has been inferred that the existing cluster head election scheme has the following limitations:

- A cluster head election scheme that uses both Poisson and exponential distribution parameter for selection is not much explored in the literature
- An ideal selection approach that re-evaluates the election of cluster head based on re-evaluation of kappa reputation coefficient is not available in the literature

A poisson exponential energy factor based cluster head selection strategy: In this study, we present a poisson-exponential Energy Factor based Cluster Head Selection Strategy (PEFCHSS) for selecting the cluster head for improving the rate of data dissemination in sensor networks .In this approach, the selection of cluster head is achieved through mixed distribution that incorporates a conditional probabilistic approach which includes events that are modeled with discrete and continuous random variable. In PEFCHSS when a source node 'S' wants to communicate with the destination node 'D', the source node 'S' broadcast control packets to all possible paths from 'S' to 'D' and the cluster heads are responsible for reliable data delivery. The election of cluster heads depends on the energy efficiency that aids it to improve the lifetime of the network. Under this condition, if suppose the lifetime of each sensor node in the routing paths between the source and the destination is 'G (t)' with 'n' number of sensor nodes in a routing path 'Y'. In this context, 'G (t)' refers to the energy rate with which a sensor node will survive in the routing path in the utilized sensor network model called Manhattan model. In this network model, base station is fixed and located far away from the sensor nodes, each sensor nodes are static, energy constrained and homogenous with a uniform energy allocation and the inter nodal distances are smaller compared to the sensor and base station distance. Then, the distribution function calculated for estimating the stability of the sensor nodes is given by Eq. 1 as:

$$F_{X/Y}(t/n) = 1-\left[1-G(t)^n\right], n = 0,1,2...,t>0 \quad (1)$$

Where 'n' and 'X' denotes the number of sensor nodes and lifetime of the routing path respectively. Further, the density function used for quantifying the survivability rate of sensor nodes is calculated based on the distribution function specified in Eq. 1 and is given by 2 as:

$$f_{X/Y}(t/n) = n\left[1-G(t)\right]^{n-1} g(t), n = 0,1,2...,t>0 \quad (2)$$

Since, the number of sensor nodes communicating at an instant increase in discrete proportion, the probability of node's survivability depends on poisson distribution. This Poisson distribution is one of the proven discrete random distributions for modeling the rate of survivability. Hence, the routing path 'Y' has a probabilistic lifetime which is Poisson validated with average node energy 'α' is given by:

$$P_y(n) = e^{-\alpha}\frac{\alpha^n}{n!} \propto > 0, n = 0,1,2,..., \quad (3)$$

Now, the joint density function that quantifies both the lifetime of nodes and each routing path is calculated using Eq. 3 and represented in Eq. 4 and 5:

$$f(t,n) = f_{X/Y}(t/n)pr(n) \quad (4)$$

$$f(t,n) = \{e^{-n}{}_0\frac{\propto^n}{(n-1)!}\left[1-G(t)\right]^{n-1} g(t), t>0, n=0,1,2..., \quad (5)$$

Furthermore, the marginal density function with which a sensor node survives routing activity is given by Eq. 6 as:

$$f_X(t) = \sum_{n=1}^{n}\left[1-G(t)\right]^{n-1} g(t)e - \propto \frac{\propto^n}{(n-1)!} \quad (6)$$

Then, the Reputation of each routing path is given by Eq. 7 as:

$$R_{X/Y}(t) = P(X > t) = \sum_{n=0}^{\infty}\left[1 - F_{X/Y}(t/n)\right]p_Y(n) \quad (7)$$

By the theorem of total probability, the reputation of each and every node in a particular path is given by Eq. 8, 9 and 10 as:

$$R_X(t) = \sum_{n=0}^{\infty}\left[1-G(t)\right]^n e - \propto \frac{\propto^n}{n!} \quad (8)$$

$$= e - \propto e^{\propto}\left[1 - G(t)\right] \quad (9)$$

$$= e - \propto G(t) \quad (10)$$

Based on the value of '$R_X(t)$, the cluster head is elected. Moreover, the cluster head selection is also re-confirmed based on kappa reputation coefficient.

Selecting cluster head based on re-evaluation of kappa reputation coefficient: When particular node is selected as the energy effective cluster head, then the energy efficient cluster head is re-confirmed based on kappa reputation coefficient which is through forward and backward probability of sensor nodes. If a node 'N_i' is monitored by 'N_j' for identifying the effectiveness in data delivery then the cumulative mean of probability that portrays the nodes sustainability is given by (11) as

$$P_{me} = P_{fp(i)} * P_{bp(j)} \quad (11)$$

Here, '$P_{fp\ (i)}$' is the forward probability estimated by neighbor 'N_j' on 'N_i' calculated through (12) as

$$P_{fp(i)} = N_{pf(i)} / P_{pr(i)} \quad (12)$$

Similarly, '$P_{bp\ (j)}$ 'is the backward probability calculated by 'N_i' about its neighbour 'N_j' estimated through Eq. 13 as:

$$P_{bp(j)} = N_{pf(j)} / N_{pri(j)} \quad (13)$$

where, $N_{pf(i)}$, $N_{pr(i)}$, $N_{pf(j)}$ and $N_{pr\ (j)}$ denotes maximum number of packets and maximum number of packets received as monitored forward by 'N_i' and 'N_j' respectively. Further, the chance agreement probability for computing the expected reliability of the monitored node 'N_i' is given by Eq. 14 as:

$$P_{ep} = P_{me} * P_{be} + (1 - P_{me})(1 - P_{be}) \quad (14)$$

Furthermore, the observed probability above 'Ni' by 'N_j' is given by Eq. 15 as:

$$P_{op} = P_{me}(1 - P_{be}) \quad (15)$$

Then, the Kappa Reliability (KUF) is manipulated by Eq. 16 as:

$$KUF = (P_{op} - P_{ep} - P_{ep}) / (1 - P_{ep}) \quad (16)$$

Based on the value of Kappa reliability factor, local clustering is initiated. Finally, the energy model incorporated in PEFCHSS is detailed as.

MATERIALS AND METHODS

Energy modle: The proposed PEFCHSS approach uses an energy model which is similar to the one contributed by Hein Zelman that is used for calculating the amount of energy utilized by the sensor nodes as given by Heinzelman *et al*. (2000). PEFCHSS uses the exhaustive set of possible channel models that belongs to the category of multipath fading. This energy model possess a inter cluster node distance of d^4 (d-distance between sensor nodes) and they suffer from d^2 power loss. The incorporation of multipath or free space model is triggered based on the distance between the inter-cluster nodes that is dynamically identified with the help of threshold parameter. The transmission cost and receiver cost in PEFCHSS used for transmitting m-bit of information is given by Eq. 17 and 18:

$$\begin{aligned} E_{TC}(m,d) &= f(x) \\ &= \{E_{ec} + m + 8f_{sd} * m * d^2, \text{if}(d < d_t) \\ &\quad E_{ec} + m + 8t_{mp} * m * d^4, \text{if}(d \geq dt) \end{aligned} \quad (17)$$

where threshold parameter:

$$d_t = \sqrt{\frac{8f_{fsd}}{8t_{mp}}} \quad (18)$$

The energy used by the amplifier for enabling a larger distance transmission in PEFCHSS is equal to $0.0018p|bit|m^4$. In contrast, the energy utilized for shorter

Table I: Simulation parameters of PEFCHSS

Parameters	Value	Description
No. of sensor nodes	100	Simulation node
Network size	100×10m	Terrain area of the network
Distance threshold	65 m	Optimal distance set for transmission
Initial energy	2.5 J	Energy availability in a sensor node before transmission
Simulation time	50 m	Maximum simulation time.
Data packets size simulation	2000 bits	Maximum size packets used in
Base station location	(60, 180 m)	Min. and max. distance of the base station from sensor nodes
No. of sensor nodes	100	Simulation node

degree transmission is. f_{sd} = 10|bit|m^2. E_{ec}, m,f_{sd} and t_{mp} represents the energy, number of bits of data transmitted, frequency for establishing connectivity between source and destination and transmission rate respectively.

Simulation experiments and analysis: In this section, the performance of PEFCHSS is implemented using ns-2 and the results are compared with the mechanisms like GROUP and FACOR. The network parameters used for simulation is described in Table 1.

Performance metrics: Generally, the reliability in data transfer of the sensor network solely depends on the cluster head of each cluster group formed through local clustering. Hence, the technique used for cluster head election may increase the packet delivery and throughput. But it may decrease the total energy consumption and packet drop rate. Hence, PEFCHSS is evaluated based on the following performance metrics.

Packet delivery ratio: Packet delivery ratio is defined as the ratio of data packets transmitted to the sink node to the number of data packets generated by the sources.

Throughput: It is defined as the aggregate sum of packets that is delivered to the sink nodes over the total simulation time.

Total energy consumption: It is the total amount of energy utilized by a sensor node to remain active in the connection establishment and packet data delivery phase.

Packet drop rate: It is the maximum number of packets dropped by a sensor node that exists between the source node and the sink nodes. The following Table 1 illustrates the simulation parameters that are set for our study.

Performance analysis of PEFCHSS: The performance investigation of PEFCHSS is achieved by carrying out three experiments and it is evaluated based on evaluation metrics like packet delivery ratio, throughput, total energy consumption and packet drop rate through:

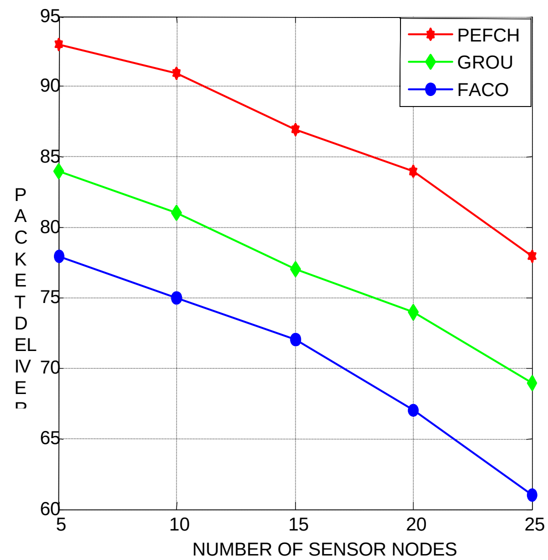

Fig. 1: Experiment 1-comparison chart for PEFCHSS based on packet delivery ratio with varying number of sensor nodes

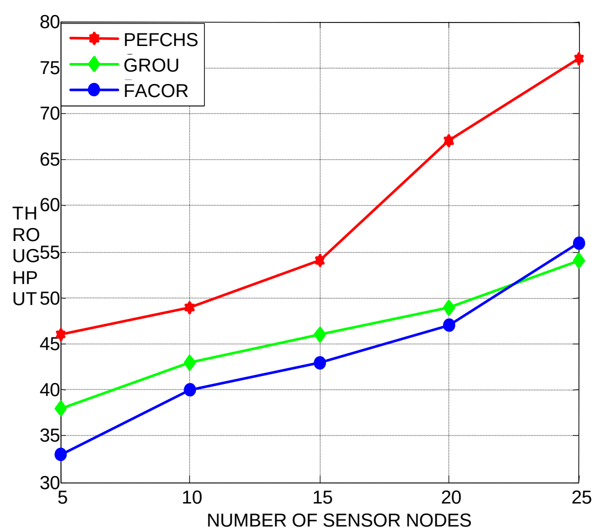

Fig. 2: Experiment 1-comparison chart for PEFCHSS based on throughput varying number of sensor nodes

- Experiment 1-varying the number of sensor nodes
- Experiment 2-varying the transmission range
- Experiment 3-varying the time of transmission

Experiment 1-performance analysis of pefchss obtained by varying the number of sensor nodes: In experiment 1, the performance of PEFCHSS is analyzed based on packet delivery ratio, total energy consumption, throughput and packet drop rate by varying the number of sensor nodes. The following Fig. 1 and 2 highlights the superior

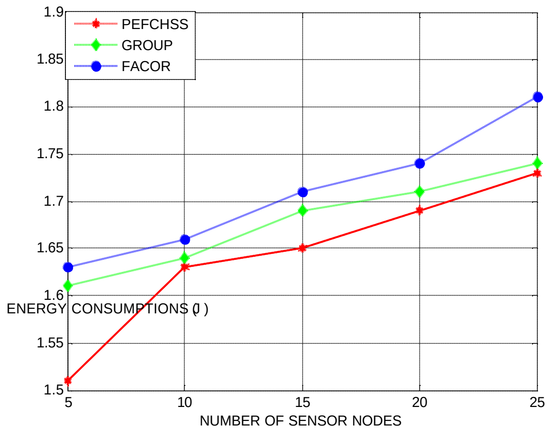

Fig. 3: Experiment 1-comparison chart for PEFCHSS based on energy consumption with varying number of sensor nodes

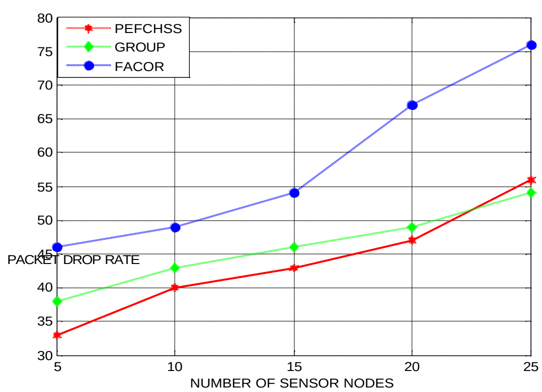

Fig. 4: Experiment 1-comparison chart for PEFCHSS based on packet drop rate with varying number of sensor nodes

performance of PEFCHSS with respect to packet delivery ratio and throughput investigated by considering the existing cluster head selection approaches like GROUP and FACOR. PEFCHSS exhibits an improvement of 15- 18% >GROUP and 23-28% superior to FACOR in terms of packet delivery ratio. Similarly, PEFCHSS shows an improvement in throughput of 17-24% > GROUP and 25-28% superior to FACOR.

It is inferred from the comparative analysis that PEFCHSS is a reliable cluster election scheme in improving the packet delivery ratio and throughput of the network as it uses kappa reliability factor for cluster head reliability and selection. Thus PEFCHSS in an average it increases the packet delivery rate and throughput to a maximum extent of 23 and 28% respectively

Likewise, Fig. 3 and 4 present the performance of PEFCHSS in comparison with GROUP and FACOR analyzed in terms of total energy consumption and packet drop rate. PEFCHSS decreases the total energy consumption rate and packet drop rate as it elects a reliable and optimal cluster head by considering each nodes packet forwarding rate and available energy. Thus PEFCHSS reduces the total energy consumption to a maximum extent of 16-21%>GROUP and 27- 33% superior to FACOR. PEFCHSS also minimizes the packet drop to a considerable level of 19-21% superior to GROUP and 25-31% >FACOR. It is also inferred that PEFCHSS is effective and efficient enough in reducing the total energy consumption and packet drop rate in an average by 29 and 31%, respectively.

RESULTS AND DISCUSSION

Experiment 2-performance analysis of pefchss obtained by varying the transmission range: In experiment 2, the performance of PEFCHSS is analyzed based on packet delivery ratio, total energy consumption, throughput and packet drop rate by varying the transmission range of the sensor nodes of the network. Figure 5 and 6 highlights the superior performance of PEFCHSS with respect to the packet delivery ratio and throughput investigated by considering the existing cluster head selection approaches like GROUP and FACOR. PEFCHSS exhibits an improvement of 13-15 % >GROUP and 21-24% superior to FACOR in terms of packet delivery ratio. Similarly, PEFCHSS shows an improvement in throughput of 15-19% >GROUP and 21-25% superior to FACOR.

It is identified that PEFCHSS is reliable in effective clustering of sensor nodes by choosing an effective cluster head even when the transmission range of the sensor nodes considerably varies. Thus, PEFCHSS improves the packet delivery ratio and throughput of the network by dynamically monitoring the node's energy parameter and its reliability factor into account for cluster head selection. Thus PEFCHSS in an average improves the packet delivery rate and throughput to a maximum extent of 18 and 23%, respectively.

Figure 7 and 8 highlights the performance of PEFCHSS in comparison with GROUP and FACOR analyzed with respect to varying transmission range of sensor nodes based on total energy consumption and packet drop rate. It is inferred that PEFCHSS decreases the total energy consumption rate and packet drop rate to a considerable level by improving the cluster head election scheme at a rapid rate of 21% superior to the baseline cluster head election approaches. PEFCHSS reduces the total energy consumption to significant level of 13-18% >GROUP and 20-27% superior to FACOR. PEFCHSS also minimizes the packet drop to a maximum extent of 18-20% superior to GROUP and 22-28%.

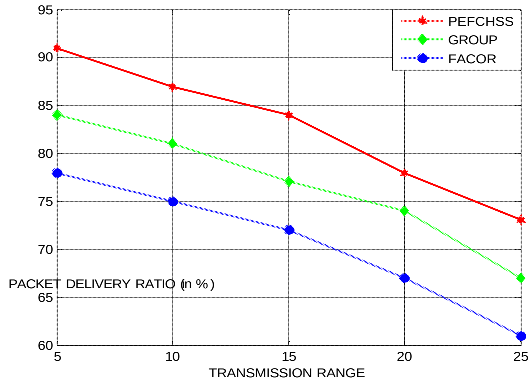

Fig. 5: Experiment 2 comparison chart for PEFCHSS based on packet delivery ratio with varying transmission range

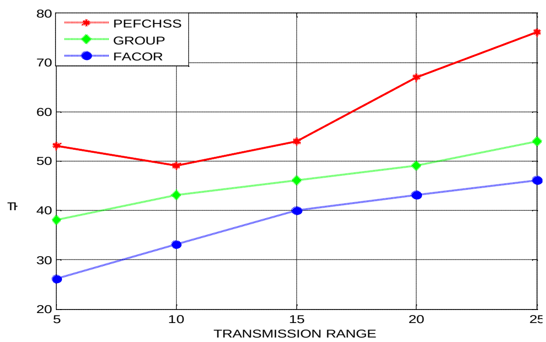

Fig. 6: Experiment 2-comparison chart for PEFCHSS based on throughput with varying transmission range

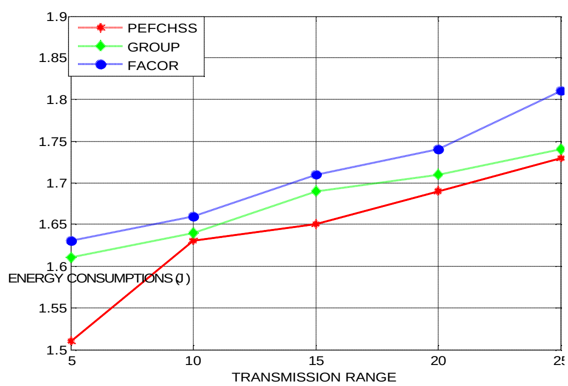

Fig. 7: Experiment 2-comparison chart for PEFCHSS based on energy consumption with varying transmission range

>FACOR. From the comparative analysis it is obvious that PEFCHSS is rapid in cluster head election and thus, improves the degree of data dissemination by balancing the energy consumption and by reducing packet drop rate in an average of 24 and 27%, respectively.

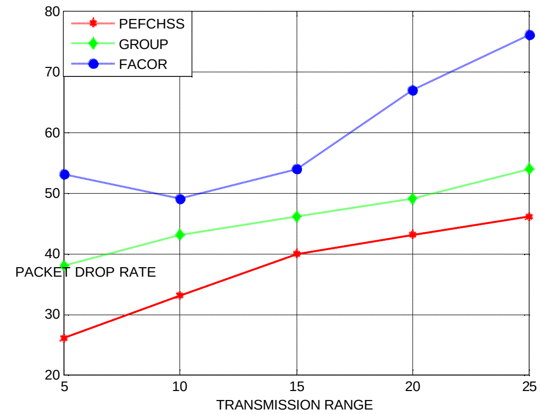

Fig. 8: Experiment 2 comparison chart for PEFCHSS based on packet drop rate varying transmission range

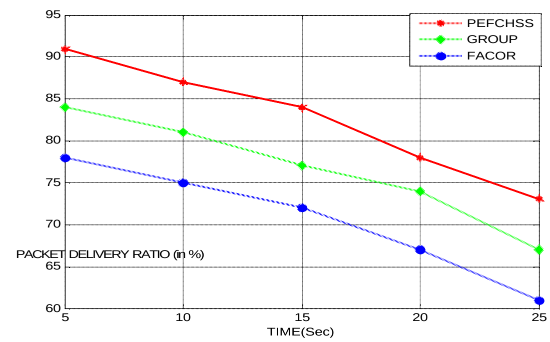

Fig. 9: Experiment 3-comparison chart for PEFCHSS based on packet delivery ratio varying time

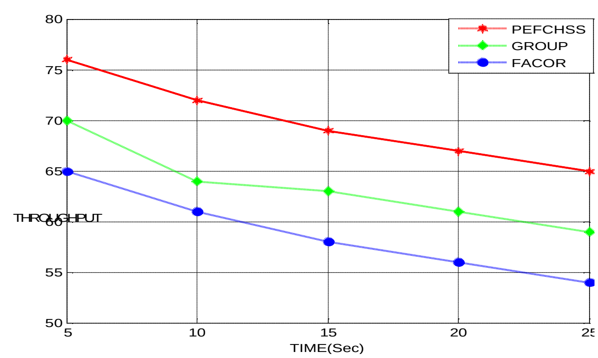

Fig. 10: Experiment 3-comparison chart for PEFCHSS based on throughput with varying time

Experiment 3-performance analysis of pefchss obtained by varying the transmission time: In experiment 3, the performance of PEFCHSS is analyzed based on packet delivery ratio, total energy consumption, throughput and packet drop rate by varying the transmission time. Figure 9 and 10 highlights the superior performance of

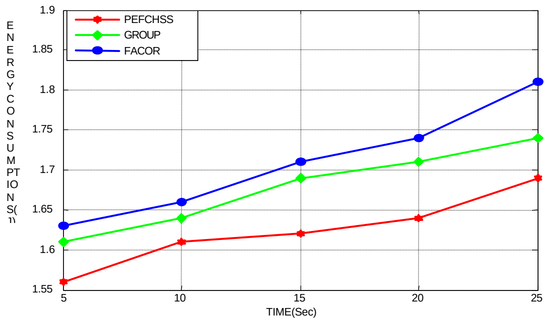

Fig. 11: Experiment 3 comparison chart for PEFCHSS based on energy consumption with varying time

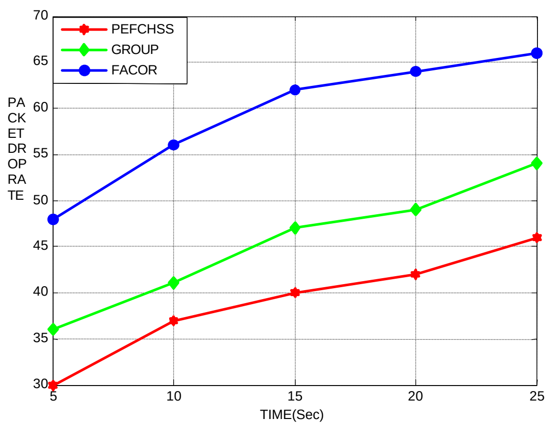

Fig. 12: Experiment 3 comparison chart for PEFCHSS based on packet drop rate with varying time

PEFCHSS with respect to the packet delivery ratio and throughput investigated by considering the existing cluster head selection approaches like GROUP and FACOR. PEFCHSS exhibits an improvement of 13-15% >GROUP and 21-24% superior to FACOR in terms of packet delivery ratio. Similarly, PEFCHSS shows an improvement in throughput of 15-19% >GROUP and 21- 25% superior to FACOR.

It is identified that PEFCHSS is fast and optimal in dynamically identifying an optimal effective cluster with increase in the transmission time utilized for analysis. PEFCHSS improves the packet delivery ratio and throughput of the network by computing a kappa reliability factor that quantifies the deviation of behavior exhibited by sensor nodes in terms of observed probability and expected probability. PEFCHSS in an average improves the packet delivery rate and throughput to a maximum extent of 19 and 22% respectively.

Figure 11 and 12 highlights the performance of PEFCHSS in comparison with GROUP and FACOR analyzed by varying the transmission time for analyzing the total energy consumption and packet drop rate of the network. It is inferred that PEFCHSS decreases the total energy consumption rate and packet drop rate to a significant degree by speeding up the rate of cluster head election scheme than the baseline cluster head election approaches used for comparison. PEFCHSS reduces the total energy consumption to significant level of 16% to 19% higher than GROUP and 22-26% superior to FACOR. PEFCHSS minimizes the packet drop to a maximum extent of 16-18% superior to GROUP and 19-24% >FACOR.

From the comparative analysis it is clear that performance of PEFCHSS is effective enough even when the transmission time of the nodes varies dynamically depending upon the incorporated cluster technique and cluster head election. Thus PEFCHSS reduces the energy consumption and packet drop rate in an average by 19 and 23%, respectively.

CONCLUSION

In this study, a mixed distribution based cluster head selection strategy is proposed based on node's reputation factor and energy. The proposed strategy not only minimizes energy utilization but also enhances the load between clusters by choosing an optimal cluster head through reputation. This approach is highly suitable to be applied in a variety of applications by varying the evaluation parameters based on the application environment. Incorporation of reputation based local clustering results in improvement of 23% when compared to the other existing strategies available in the literature. Thus PEFCHSS reduces the rate of energy consumption and the communication cost to a considerable level. The results obtained through simulation portrays that PEFCHSS enhances the network lifetime at a maximum rate of 23% superior to the existing energy-based cluster head election schemes like GROUP and FACOR.

REFERENCES

Abbasi, A.A. and M. Younis, 2007. A survey on clustering algorithms for wireless sensor networks. Comput. Commun., 30: 2826-2841.

Akyildiz, I.F., W. Su, Y. Sankarasubramaniam and E. Cayirci, 2002. Wireless sensor networks: A survey. Comput. Networks, 38: 393-422.

Amiri, E., H. Keshavarz, M. Alizadeh, M. Zamani and T. Khodadadi, 2014. Energy efficient routing in wireless sensor networks based on fuzzy ant colony optimization. Int. J. Distrib. Sens. Networks, 2014: 1-17.

Chakraborty, A., S.K. Mitra and M.K. Naskar, 2011. A Genetic algorithm inspired routing protocol for wireless sensor networks. Int. J. Comput. Intell. Theor. Pract., 6: 1-8.

Chatterjee, M., S.K. Das and D. Turgut, 2002. WCA: A weighted clustering algorithm for mobile Ad Hoc networks. Cluster Comput., 5: 193-204.

Cheng, H., K. Li, X. Sun, H. Wang and X. Zhao, 2012. Performance analysis of wsns clustering protocol based-on poisson distribution. Comput. Measur. Control, 20: 2590-2592.

Francesco, D.M., K. Shah, M. Kumar and G. Anastasi, 2010. An Adaptive Strategy for Energy-Efficient Data Collection in Sparse Wireless Sensor Networks. In: In: Wireless Sensor Networks, Silva, J.S., B. Krishnamachari and F. Boavida (Eds.). Springer, Berlin, Germany, ISBN:978-3-642-11916-3, pp: 322-337.

Geetha, V.A., P.V. Kallapur and S. Tellajeera, 2012. Clustering in wireless sensor networks: Performance comparison of LEACH and LEACH-C protocols using NS2. Procedia Technol., 4: 163-170.

Heinzelman, W.B., A.P. Chandrakasan and H. Balakrishnan, 2002. An application-specific protocol architecture for wireless microsensor networks. IEEE Trans. Wireless Commun., 1: 660-670.

Heinzelman, W.R., A. Chandrakasan and H. Balakrishnan, 2000. Energy-efficient communication protocol for wireless microsensor networks. Proceedings of the 33rd Annual Hawaii International Conference on System Sciences, January 4-7, 2000, Maui, HI., USA., pp: 1-10.

Hussain, S., O. Islam and A.W. Matin, 2007. Genetic algorithm for energy efficient clusters in wireless sensor networks. Proceedings of the 4th International Conference on Information Technology, April 2-4, 2007, Las Vegas, NV., pp: 147-154.

Kawadia, V. and P.R. Kumar, 2005. Principles and protocols for power control in wireless ad hoc networks. IEEE J. Sel. Areas Commun., 23: 76-88.

Maheswar, R. and R. Jayaparvathy, 2011. Performance analysis of cluster based sensor networks using N-policy M-G-1 queueing model. Eur. J. Sci. Res., 58: 177-188.

Nie, J., D. Li, Y. Han and S. Xie, 2010. The optimized method of cluster-head deployment based on GA-WCA in wireless sensor networks. Proceedings of the 2010 International Conference on Computer Application and System Modeling (ICCASM 2010), October 22-24, 2010, IEEE, Ji'an, China, ISBN:978-1-4244-7235-2, pp: 412-449.

Pandey, K.K., N. Purohit and A. Agarwal, 2014. Efficient clustering technique for cooperative wireless sensor network. Int. J. Comput. Network Inf. Secur., 6: 40-47.

Rajarajeswari, P.L. and N.K. Karthikeyan, 2015. A Pareto Survivor Function Based Cluster Head Selection Mechanism (PSFCHSM) to Mitigate Selfish Nodes in Wireless Sensor Networks. In: In: Security in Computing and Communications, Abawajy, J.H., S. Mukherjea, S.M. Thampi and A.R. Martinez (Eds.). Springer, New York, USA., ISBN:978-3-319-22914-0, pp: 381-391.

Ran, G., H. Zhang and S. Gong, 2010. Improving on LEACH protocol of wireless sensor networks using fuzzy logic. J. Inform. Comput. Sci., 7: 767-775.

Rana, K. and M. Zaveri, 2013. Synthesized cluster head selection and routing for two tier wireless sensor network. J. Comput. Networks Commun., 2013: 1-11.

Shu, W. and J. Wang, 2013. An optimized multi-hop routing algorithm based on clonal selection strategy for energy-efficient management in wireless sensor networks. Sens. Transducers, 22: 8-14.

Younis, O. and S. Fahmy, 2004. HEED: A hybrid, energy-efficient, distributed clustering approach for ad hoc sensor networks. IEEE Trans. Mobile Comput., 3: 366-379.

Zhang, C., 2010. Cluster-based routing algorithms using spatial data correlation for wireless sensor networks. J. Commun., 5: 232-238.