Region Based Adaptive Energy Efficient Scheme (RBAEES) Explorations for Distributed Heterogeneous Mobile Networks

VINOD KUMAR VERMA
Department of Computer science and Engineering
Sant Longowal Institute of Engineering and Technology
Deemed University under Ministry of Human Resource Development
Longowal -148106, Sangrur, Punjab, Established By: Government of India
INDIA
vinod5881@gmail.com http://cs.sliet.ac.in/people/vinodverma/

Abstract: - Distributed heterogeneous networks are given major attention for mobile system nowadays. These systems co-relate all the major applications affecting the daily life. This paper explores the past research effort in the direction of energy efficient schemes for mobile networks. Moreover, we designed and developed a model based on the region based approach for distributed mobile networks the. Additionally, we assessed our model on performance based parameters. Next, the results obtained from the investigations can be helpful for the distributed mobile networks designers. Finally, simulation explorations have been carried to validate our proposed scheme.

Key-Words: - Region, energy, mobile, distributed, networks.

1 Introduction

Heterogeneous mobile networks become the major field of research among researchers due to its wider sphere affecting our daily life. The availability of heterogeneity present in the network severely affects the performance of any distributed mobile systems. Energy efficient is the major factor can enhance the lifetime of mobile applications. This depends on the way to handle the data present in the networks. Distributed energy efficient schemes are always preferred in mobile networks. The region over which these schemes are deployed also effect the functioning of mobile systems. In this paper, we focused on the one of the distributed energy efficient scheme namely: Region Based Adaptive Energy Efficient Scheme (RBAEES). We comprehensively evaluated this scheme and present our investigations that surely help the distributed mobile system designer.

The layout of this paper is described in the following sections. Section 2 reported the related work in distributed mobile networks. Section 3 presented our proposed adaptive energy efficient model Section 4 highlights the detailed setup. Section 5 describes the results and discussion of the designated model. Finally, conclusions are made in Section 6.

2 Related Work in Distributed Mobile Networks

The past research efforts in the direction of energy efficient mobile networks are as follows. Heinzelman et al. [1] in 2000 presented Energy-efficient communication protocol for wireless micro sensor networks. Manjeshwar and Agrawal [2] in 2001 proposed TEEN: a routing protocol for enhanced efficiency in wireless sensor networks based on mode of functioning as proactive data collection, reactive data change and formal classification of sensor network. Li et al. [3] in 2001 presented hierarchical power-aware routing in sensor networks for large sensor network with online power aware routing. Heinzelman et al. [4] in 2002 proposed application-specific protocol architecture for wireless micro sensor networks. Lindsey and Raghavendra [5] in 2002 presented PEGASIS: power-efficient gathering in sensor information systems focused on energy consumption issue. Manjeshwar and Agrawal [6] in 2002 presented APTEEN: A hybrid protocol for efficient routing and comprehensive information retrieval in wireless sensor networks. Karaki et al.[7] in 2004 proposed data aggregation in wireless sensor networks-exact and approximate algorithms. Luo et al. [8] in 2005 proposed TTDD: Two-tier data dissemination in large-scale wireless sensor networks. Muruganathan et al. [9] in 2005 presented a centralized energy-efficient routing protocol for wireless sensor networks. Yuan et al. [10] in 2006 presented virtual MIMO-based cross-layer design for wireless sensor networks by using cross layer design a communication protocol to improve energy efficiency, reliability and end-to-end delay. Qing et al. [11] in 2006 proposed design of a distributed energy-efficient clustering algorithm for heterogeneous wireless sensor networks for reducing energy consumption, increasing scalability and network lifetime. Wu et al. [12] in 2007 presented energy efficient sleep/wake scheduling for multi-hop sensor networks for low duty cycle sensor node sleep/wake scheduling with effect of synchronization error is proposed. Sharma et al. [13] in 2008 proposed GBDD: Grid based data dissemination in wireless sensor networks for data dissemination as a big challenge. Kandris et al. [14] in 2009 proposed power conservation through energy efficient routing in wireless sensor networks where, energy is taken as a major concern and during communication it is more sensitive. Elbhiri et al. [15] in 2010 proposed distributed energy-efficient clustering (DDEEC) for heterogeneous wireless sensor networks. Lung et al. [16] in 2010 presented using hierarchical agglomerative clustering in wireless sensor networks for the advantage of providing scalable and resource efficient solutions. Vinod Kumar Verma [17] presented performance assessment of adhoc on demand distance vector routing (AODV) routing protocol over temperature constraints in wireless sensor network. Verma et al. [18] terrain investigations of adhoc on demand distance vector routing (AODV) routing protocol over temporal constraints in wireless sensor network. Verma et al. [19] reported analytical event based investigations over delphi random generator distributions for data dissemination routing protocols in highly dense wireless sensor networks. Verma et al. [20] highlighted optimized battery models estimation for static, distance vector and on-demand based routing protocols over 802.11 enabled wireless sensor networks. Verma et al. [21] comprehensive event based estimation of sensor node distribution strategies using classical flooding routing protocol in wireless sensor networks. Verma et al. [22] Simulative exploration of power trust and reputation model over power node augmentation factor in distributed peer to peer networks. By reviewing these research efforts, it is observed that there is still need to work in the direction of efficient scheme for distributed heterogeneous mobile networks. The proposed scheme energy efficient region based scheme is described in next section.

3. Region Based Adaptive Energy Efficient Scheme (RBAEES) Model RBAEES

We proposed and implemented an adaptive energy efficient transmission scheme using mobile sink for wireless sensor networks. We have taken 100 nodes deployed over 100 m × 100 m area for our proposed scheme. We calculated the aggregate transmission energy (ETA} at the sender and transmitter side. Next, signal to noise ratio (SNR) is calculated for our proposed framework. We have randomly selected the temperature in range from [-10(C)-53(C)]. Then, we estimated RSSI-loss (dBm) for given temperature. To estimate required transmitter power level for given RSSI, we divided the proposed network into three regions on basis of RSSI-loss. We calculated the minimum value, maximum value and average value in array. Then, we computed the number of nodes in A region (RSSIH), the number of nodes in B region (RSSIM) and the number of nodes in C region (RSSIL). We estimated RSSI and power level (Plevel) for each node in region A, power level (Plevel) for each node in region B and power level (Plevel) for each node in region C. The mean value of RSSI (Threshold) for each region is calculated. Next, we estimated corresponding power level and defined the rounds. To estimate required transmitter power for given RSSI, we generated scenario for region A, for region B and for region C. Also, we computed power saving for A region, power saving for B region and power saving for C region.

4 Detailed Setup

We use the MATLAB version 2010a over the WINDOWS platform for the designing and implementation of our proposed model. The simulation scenario of the deployed network is shown in figure 4.1. We used the following parameters in our proposed model. The diameter of sensor network 100 m, distance of base station from the network 100 m, number of nodes 100, probability of a node to become cluster head 10 %. The .energy supplied to each node 0.5 J, transmitter energy per node 0.00000005 J, receiver energy per node 0.00000005 J, amplification energy when d is less than d_0 0.000000000001 J, amplification energy when d is greater than d_0 0.0000000000000013 J , data aggregation energy 0.000000005. Table 1 shows the parameters summarization for our proposed scheme.

Table 1: RBAEES parameters

Parameters	Value
Nodes	100
Area	100 m × 100 m
Aggregate Transmission energy (ETA)	0.003 J
Signal to noise ratio (SNR)	0.0203
Temperature	-10(C)- 53(C)
Network Regions	3
Network Deployment	Random

The simulation scenario is shown in figure 1. In the snapshot, circle shows the number of nodes deployed in the random manner.

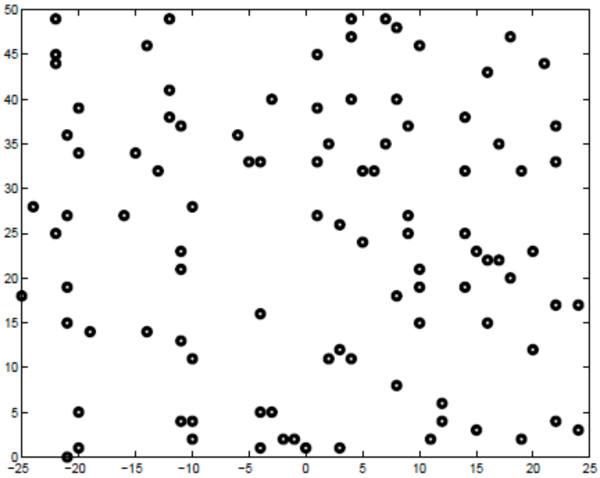

Fig. 1. Simulation Snapshot

5 Results and Discussion

We design and implemented adaptive energy efficient scheme for wireless sensor networks. We focused on transmission power and time factors for our evaluations under different conditions. the mobile sink is evaluated with respect to different X,Y coordinate values. We set the five coordinate values for the mobile sink namely: (i) (50,50) (ii) (50,50) – (0,0) (iii) (0,0) – (0,100) (iv) (0,100) – (100,100) (v) (100,100) – (100,100). We divided the simulation scenario into three regions A,B and C. In region A, RSSI value is high. In region B, RSSI value is low. In region C, RSSI value is the average of the high and low values. The value of transmitter power shows non linear behaviour on all the X,Y coordinate values as shown in figure 2. The transmission power save value remains maximum at (50,50) coordinate values then rest of the cases. This is due to the fact that under first coordinate values, it has to consider only one coordinate values. Other coordinate system uses two values resulting in higher power consumption.

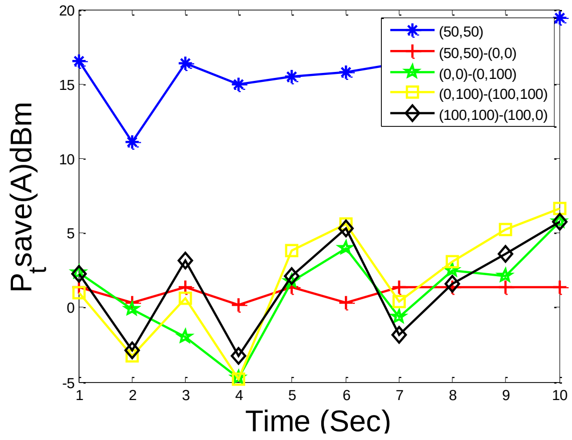

Figure 2: Transmitter power level versus time analysis for region A

Next, we observed the power level saving for the region B. Overall, the scenario shows higher power consumption. We noticed that the power saving remains higher on first coordinate value as compared to other coordinate values. It is observed from the figure 3 that the power consumption depicts non linear behaviour in all the cases. As the power saving remains higher in region B at 10 sec for first coordinate values and lowest at the second coordinate positions.

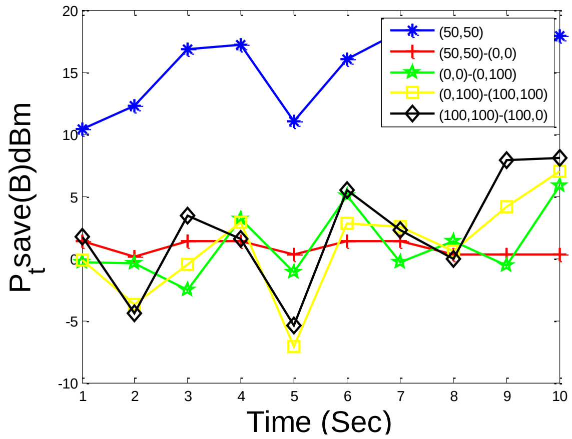

Figure 3: Transmitter power level versus time analysis for region B

Next, we observed in region C, the behaviour of five coordinate points as shown in figure 4.. It is noticed from the figure 4 that the fifth point coordinates shows better behaviour that rest of the coordinate points. We also noticed that non linearity exists more in the region C. Specifically, second point coordinates shows linear behaviour as compared to the other point coordinates. There exist relation between power saving and the time. Power saving reduces with respect to the time and also depending on the sink position in the proposed model.

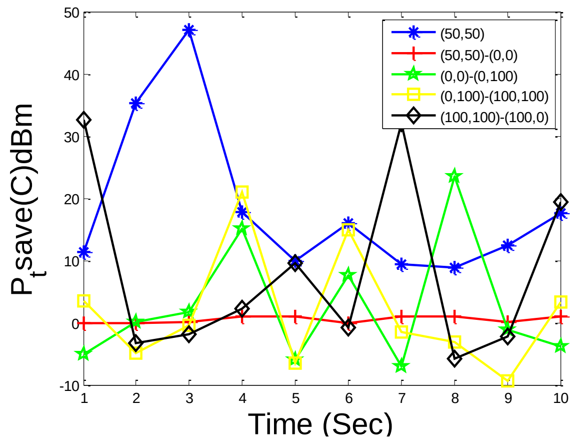

Figure 4: Transmitter power level versus time analysis for region C

Further, we observed transmitter power at (50,50) coordinate individually as shown in figure 5. It is observed from the figure 5.15 that the power value remains -84.8 dBm,, -83 dBm, -85.1 dBm, -87 dBm, -83..6 dBm, -85.1 dBm,-84.1 dBm,-84 dBm,-85.1 dBm,-85 dBm respectively. These values are corresponding to the tine spam from 1 sec to 10 sec. The value of transmitter power remains maximum at 2 sec and minimum at 4 sec in the proposed framework.

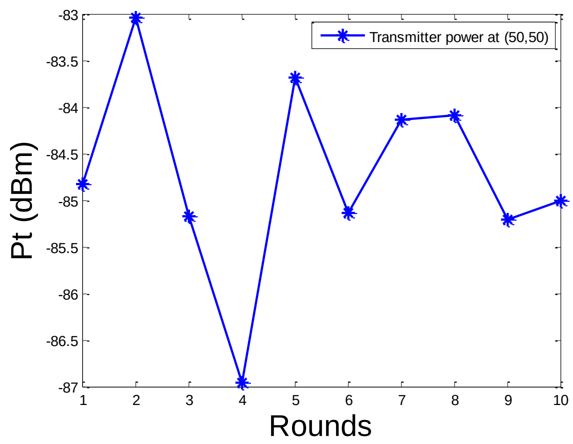

Figure 5: Transmitter power versus round analysis first level

\Next, we observed transmitter power at (0, 0) coordinate individually as shown in figure 6.. It is observed from the figure 5.16 that the power value remains -70.6 dBm,, -70.8 dBm, -69.9 dBm, -71.4 dBm, -70.5 dBm, -69 dBm, -70.3 dBm, -70.5 dBm, -69.8 dBm, -69.5 dBm respectively. These values are corresponding to the tine spam from 1 sec to 10 sec. The value of transmitter power remains maximum at 6 sec and minimum at 4 sec in the proposed framework.

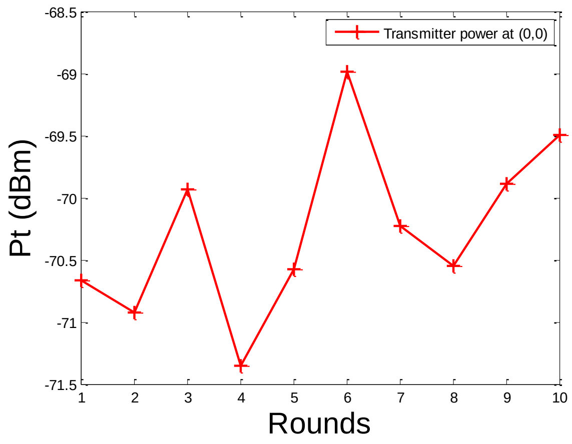

Figure 6: Transmitter power versus round analysis second level

Further, we observed transmitter power at (0,100) coordinate individually as shown in figure 7. It is)observed from the figure 5.17 that the power value remains -73 dBm,, -69.9 dBm, -70.5 dBm, -70.4 dBm, -72 dBm, -70.8 dBm, -70 dBm, -69.8 dBm, -69.9 dBm, -70.6 dBm respectively. These values are corresponding to the tine spam from 1 sec to 10 sec. The value of transmitter power remains maximum at 8 sec and minimum at 1 sec in the proposed framework.

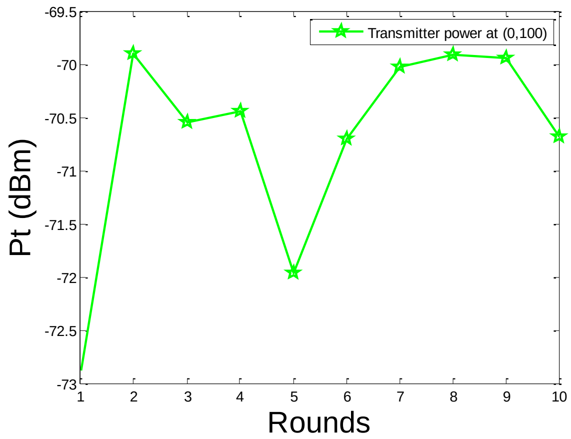

Figure 7: Transmitter power versus round analysis third level

Next, we observed transmitter power at (100,100) coordinate individually as shown in figure 8. It is)observed from the figure 5.18 that the power value remains -70.4 dBm,, -69.6 dBm, -72.1 dBm, -70.6 dBm, -71.3 dBm, -71.5 dBm, -71 dBm, -71.3 dBm,

-72.5 dBm, -70.7 dBm respectively. These values are corresponding to the time spam from 1 sec to 10 sec. The value of transmitter power remains maximum at 2 sec and minimum at 9 sec in the proposed framework.

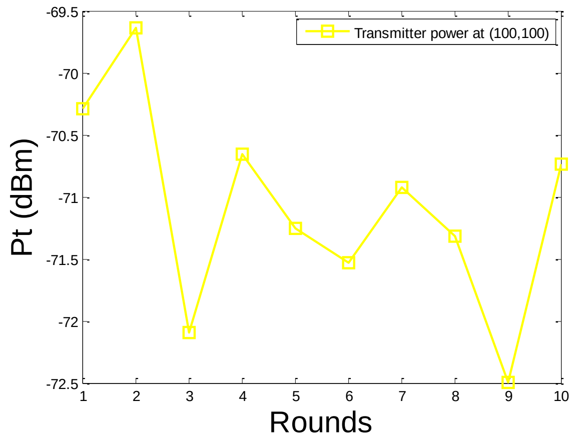

Figure 8; Transmitter power versus round analysis forth level

Further, we observed transmitter power at (100, 0) coordinate individually as shown in figure 9. It is)observed from the figure 5.19 that the power value remains -70 dBm,, -69 dBm, -81 dBm, -120 dBm, -62 dBm, -63 dBm, -66 dBm, -68 dBm, -70 dBm, -60 dBm respectively. These values are corresponding to the time spam from 1 sec to 10 sec. The value of transmitter power remains maximum at 10 sec and minimum at 4 sec in the proposed framework.

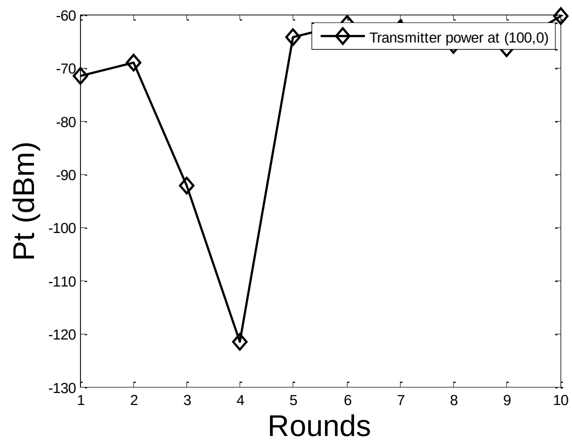

Figure 9: Transmitter power versus round analysis fifth level

In summation, we implemented and evaluated our proposed RBAEES for wireless sensor network over mobile sink positions at five levels,

6. Conclusions

This paper made inclusive explorations of round based adaptive energy efficient scheme for distributed heterogeneous mobile networks. We design and implemented adaptive energy efficient scheme for wireless sensor networks. We focused on transmission power and time factors for our evaluations under different conditions. The mobile sink is evaluated with respect to different X, Y coordinate values. We focused on region fragmentation aspect our investigations. We observed that the transmitter power and its level severely affected by the time and round factors. In the future, we will work for the enhancement of our proposed scheme for mobile networks.

References:

[1] Heinzelman, W. R., Chandrakasan, A., & Balakrishnan, H. (2000, January). Energy-efficient communication protocol for wireless microsensor networks. In System sciences, 2000. Proceedings of the 33rd annual Hawaii international conference on (pp. 10-pp). IEEE.

[2] Manjeshwar, A., & Agrawal, D. P. (2001, April). TEEN: a routing protocol for enhanced efficiency in wireless sensor networks. In null (p. 30189a). IEEE.

[3] Li, Q., Aslam, J., & Rus, D. (2001, May). Hierarchical power-aware routing in sensor networks. In Proceedings of the DIMACS workshop on pervasive networking.

[4] Heinzelman, W. B., Chandrakasan, A. P., & Balakrishnan, H. (2002). Application-specific protocol architecture for wireless micro sensor networks. Wireless Communications, IEEE Transactions on, 1(4), 660-670.

[5] S. Lindsey, C.Raghavendra, "PEGASIS: Power-Efficient GAthering in Sensor Information Systems," In Proc. IEEE Aerospace Conference, USA, Montana, 2002, Vol. 3, pp. 1125-1130.

[6] Manjeshwar, A., & Agrawal, D. P. (2002, April). APTEEN: A hybrid protocol for efficient routing and comprehensive information retrieval in wireless sensor networks. In ipdps (p. 0195b). IEEE.

[7] Al-Karaki, J. N., Ul-Mustafa, R., & Kamal, A. E. (2004). Data aggregation in wireless sensor networks-exact and approximate algorithms. In High Performance Switching and Routing, 2004. HPSR. 2004 Workshop on (pp. 241-245). IEEE.

[8] Luo, H., Ye, F., Cheng, J., Lu, S., & Zhang, L. (2005). TTDD: Two-tier data dissemination in large-scale wireless sensor networks. Wireless Networks, 11(1-2), 161-175.

[9] Muruganathan, S. D., Ma, D. C., Bhasin, R., & Fapojuwo, A. O. (2005). A centralized energy-efficient routing protocol for wireless sensor networks. Communications Magazine, IEEE, 43(3), S8-13.

[10] Yuan, Y., He, Z., & Chen, M. (2006). Virtual MIMO-based cross-layer design for wireless sensor networks. Vehicular Technology, IEEE Transactions on,55(3), 856-864.

[11] Qing, L., Zhu, Q., & Wang, M. (2006). Design of a distributed energy-efficient clustering algorithm for heterogeneous wireless sensor networks. Computer communications, 29(12), 2230-2237.

[12] Wu, Y., Fahmy, S., & Shroff, N. B. (2007, May). Energy efficient sleep/wake scheduling for multi-hop sensor networks: Non-convexity and approximation algorithm. In INFOCOM 2007. 26th IEEE International Conference on Computer Communications. IEEE (pp. 1568-1576). IEEE.

[13] Sharma, T. P., Joshi, R. C., & Misra, M. (2008, December). GBDD: Grid based data dissemination in wireless sensor networks. In Advanced Computing and Communications, 2008. ADCOM 2008. 16th International Conference on (pp. 234-240). IEEE.

[14] Kandris, D., Tsioumas, P., Tzes, A., Nikolakopoulos, G., & Vergados, D. D. (2009). Power conservation through energy efficient routing in wireless sensor networks .Sensors, 9(9), 7320-7342.

[15] Elbhiri, B., Saadane, R., El Fkihi, S., & Aboutajdine, D. (2010, September). Developed Distributed Energy-Efficient Clustering (DDEEC) for heterogeneous wireless sensor networks. In I/V Communications and Mobile Network (ISVC), 2010 5th International Symposium on (pp. 1-4). IEEE.

[16] Lung, C. H., & Zhou, C. (2010). Using hierarchical agglomerative clustering in wireless sensor networks: An energy-efficient and flexible approach. Ad Hoc Networks, 8(3), 328-344.

[17] Vinod Kumar Verma. Performance Assessment of AODV Routing Protocol over Temperature Constraints in Wireless Sensor Network. Published in proceeding of 11th WSEAS International Conference on Electronics, Hardware, Wireless and Optical Communication (EHAC '12), Recent Researches in Communications, Electronics, Signal Processing and Automatic Control, pp. 74-77, ISBN: 978-1-61804-069-5, Cambridge, United Kingdom (UK), February 22- 24, 2012.

[18] Vinod Kumar Verma, Surinder Singh, N. P. Pathak, Terrain Investigations of AODV Routing Protocol over Temporal Constraints in Wireless Sensor Network. Published in proceeding of 1th WSEAS International Conference on Electronics, Hardware, Wireless and Optical Communication (EHAC '12), Recent Researches in Communications, Electronics, Signal Processing and Automatic Control, Isbn: 978-1-61804-069-5, Cambridge, United Kingdom (UK), February 22- 24, 2012.

[19] Vinod Kumar Verma, Surinder Singh, and N.P. Pathak. Analytical Event Based Investigations Over Delphi Random Generator Distributions for Data Dissemination Routing Protocols in Highly Dense Wireless Sensor Networks. Published in Wireless Personal Communications: An International Journal © Springer Science + Business Media New York 2015.

[20] Vinod Kumar Verma, Surinder Singh and N.P. Pathak. Optimized Battery Models Estimation for Static, Distance Vector and On-Demand Based Routing Protocols over 802.11 Enabled Wireless Sensor Networks, Published in Wireless Personal Communications: An International Journal, © Springer Science + Business Media New York 2014.

[21] Vinod Kumar Verma, Surinder Singh, and N.P. Pathak . Comprehensive Event Based Estimation of Sensor Node Distribution Strategies using Classical Flooding Routing Protocol in Wireless Sensor Networks. Published in Wireless Networks: The Journal of Mobile Communication, Computation and Information. Volume 20, pp.2349-2357. © Springer Science + Business Media New York 2014.

[22] Vinod Kumar Verma. Simulative Exploration of Power Trust and Reputation Model over Power Node Augmentation Factor in Distributed Peer to Peer Networks. Published in WSEAS 18th International Conference on Automatic Control, Modelling & Simulation (ACMOS '16), VENICE, ITALY. Jan. 29- 31, 2016.