International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 4 Issue 5, August 2020 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

A Complete Analysis of Corona Based Energy Efficient WSN Protocols

Meenakshi[1], Kirti Bhatia[2], Shalini Bhadola[2]

[1]Student, [2]Assistant Professor,
[1,2]Sat Kabir Institute of Technology and Management, Jhajjar, Haryana, India

ABSTRACT

The main components of a wireless sensor network (WSN) are relay nodes, large number of sensor nodes, and a base station. The WSN is chiefly deployed to gather information from an environment. Due to its applicability, the WSN has become very popular and it is being used in a variety of applications, like habitat observing, exactitude agriculture, intelligent homes and military reconnaissance. In case of different applications, an efficient deployment of WSN is required so that occurrence of any event is monitored accurately. The uneven deployment of sensor node can cause coverage-holes and energy holes problems in the network. If coverage hole is present in a target area, then every point in the area cannot be covered while the formation of energy-holes means that data can no long delivered to the sink on certain path. This particular time instance has been defined as the total network lifetime. As balanced energy consumption among the sensor nodes of the WSN is the most challenging problem due to many-to-one traffic pattern. The goal of our survey is to present a comprehensive review of the recent literature of sensor node deployment. In this paper, we have reviewed the existing Corona-based sensor node deployment strategies. We review the major development in these deployment strategies and outline the new challenges. Their simulation results showed that each deployment strategy significantly utilized the energy of the nodes and prolongs the network lifetime.

KEYWORDS: *Wireless Sensor Network, Corona, Deployment Strategy*

How to cite this paper: Meenakshi | Kirti Bhatia | Shalini Bhadola "A Complete Analysis of Corona Based Energy Efficient WSN Protocols" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-4 | Issue-5, August 2020, pp.66-71, URL: www.ijtsrd.com/papers/ijtsrd31717.pdf

IJTSRD31717

1. INTRODUCTION

Low price, less power and multi-purpose minute sensor nodes came into existence due to the rapid development in wireless communications and micro-electro-mechanical systems [1]. These sensor nodes are used in the sensing and collecting of information from the atmosphere. The collected information has been transmitted to the base station. This scenario is known as Wireless Sensor Network. In a WSN, a large number of sensor nodes such as temperature sensors, pressure sensors, and light sensors are deployed randomly or deterministically over a region of interest to monitor the physical or environmental conditions. These sensor nodes collect in formation and send data to the base station either directly or using multi hop communication. The deployment of these sensor nodes significantly depends on the type of applications used.

With respect to application areas, Wireless Sensor Networks have generated interest in a variety of applications such as forest monitoring, disaster management, factory automation, and space exploration. In all of these cases, the sensors operate in a non-attended environment and are used for recording environmental changes (e.g., temperature, humidity, visual or infrared light, and pressure). Some areas have specialized sensors, for instance, chemical sensors which can detect gas leaks, soil composition, oil leaks in oceans, nuclear and bio-chemical hazards etc. In surveillance, magnetic sensors can be used to detect passing vehicles or radar based sensors can also be used.

Energy efficiency is the most challenging problem in WSNs due to the obvious reasons of limited battery capacity. Optimized balanced energy consumption using sensor node deployment is more challenging. In case of irregular sensor node deployment different kind of holes in a network can be created such as coverage-holes and energy-holes.

The existence of the coverage-hole in the monitored area means that every point in the target area is not being covered and the energy-holes occur due to the converge-cast or many-to-one traffic pattern in WSNs. The nodes closer to the sink carry greater traffic loads irrespective of the model of communication(multi-hop, direct, or cluster).This pattern results in energy depletion within the area closer to the sink and the formation of what is called “energy-holes”. Once created, the process is irreversible and the network operation of the remaining system is worthless because data can no longer be delivered to the sink on the optimized paths. This instance can be called the total network lifetime.

Throughout this Paper, we have focused on the significance of deployment strategies of WSN and how to maximize network lifetime and improved balanced energy consumption using these deployment strategies. Moreover certain problems like coverage-holes [2] and the energy-holes [3] can also be resolved using these strategies. We have discussed two main strategies of sensor node deployment: (1) Non-corona type and (2) Corona-based node deployment strategies. There are several objectives of Corona based sensor node deployment strategy and hence strategies are like; Engineered based Gaussian; corona based using least number of sensor nodes to attain complete coverage; corona based arithmetic and geometric proportions; corona based optimal sensor nodes positioning with complete coverage for optimal energy consumption; and corona based relay nodes which evade surplus data transmission.

Corona model focus on the following points:

A. In WSN, what should be the adequate number of sensors nearby sink to handle multi-hop transmission?
B. In corona based method, what should be the adequate number of sensors in every corona so that there is balanced energy depletion in WSN.
C. How many sensors are required to attain full coverage
D. How to manage duplicate data transmission and links in dense WSN.
E. How to accomplish balanced energy diminution among coronas in WSN.

2. Classification of deployment strategies:

The main objectives of sensor node deployment are to accomplish full coverage and to improve energy consumption. The relay nodes are used to relay the data packets in the network and deployed in such a way as to avoid redundant data transmission towards the sink and distributed with the sensor nodes in such a pattern as to maximize the balanced energy consumption. In a few application areas such as remote surveillance, a manual deployment is not feasible at all. In such application areas, nodes can be deployed by aircrafts; however, such deployment strategies cannot be controlled.

In an area, three main aspects influence the node placement; the operational environment, type of application, and variety of sensors. Performance of WSN is influenced by the optimum placement strategies.

In this paper, we have reviewed several deployment schemes of sensor node deployment strategies along with their benefits and drawbacks. The key category of static deployments has been focused on non-corona centered and corona centered deployments.

3. Non-Corona Based Strategies

This section describes Non-corona based strategies

A. Cluster Centered Strategies

In sensor networks, the LEACH [4] is a popular energy balancing protocol. Here sensors have been clustered into cluster members and cluster heads. These heads accept data from members, combined it and convey to the sink. The cluster head changes at each round, so that there is a reduction in energy. However, there is an uneven dispersal of cluster heads in LEACH. There is a likelihood that nodes in a zone are not cover up by any CH may cause higher energy exhaustion and consequently creates energy holes.

Rasheed et al. have proposed energy efficient hole removing mechanism [5]. They have used sleep and awake mechanism to save energy of sensors. Further they have calculated a threshold energy required for transmission. If nodes' energy falls below threshold value, nodes do not transmit and goes to sleep state. Nodes far off the sink increases sleep probability. As some nodes are always in sleep mode they can rest and activate when energy of other nodes depleted. However distribution of sleep nodes is not uniform over the network. It is possible that some nodes are in sleep mode and some have depleted their energy near the sink node. Now network will not work. Figure 1 describes clustering mechanism for sensor network.

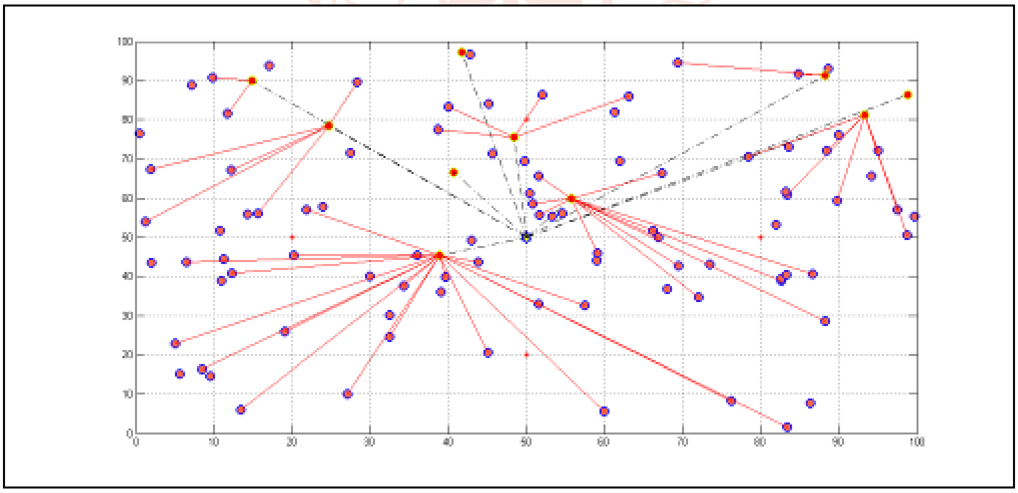

Fig 1: cluster based strategy

B. Non-Uniform Node Distribution Strategies

Wu et al. have examined the theoretical traits of the non-uniform node distribution strategy in WSNs, to avoid the energy holes nearby the sink [6]. They proved that suboptimal energy efficiency is possible in inward portions of network if the number of nodes upsurges with geometric proportion from the outward parts to the inward ones. This strategy achieves almost balanced energy consumption, and merely less than 10% of the total energy is unexploited when the network lifetime has finished. Wu et al. further used q-switch routing protocol to avoid energy holes in network with non-uniform node distribution [7]. Authors in [8] have combined the advantages of unequal cluster size and non-uniform node distribution, to eliminate the energy holes problem.

C. Region Based Strategies
Zhang et al. have divided the sensing field in to several regions and placed more sensors in the areas nearer to the sink. They have examined the spatially unbalanced energy consumption of the region based routing scheme [9]. Nadeem et al. have also divide the region in to multiple region and used dual communication technique in sink region and cluster region. They have used gateway node to assist transmission between cluster heads and the sink [10].

D. Location Based Strategies
There exist some deployment strategies where location of nodes is fixed. There is no random distribution of nodes like in clustering based protocols. Halder et al. have given a deployment strategy where location of nodes is predetermined [11]. They have divided Network coverage area is into systematic hexagonal cells and layers. The cells of the layer are further categorized in to primary and secondary cells. This approach has improved network lifetime but lacks of flexibility as nodes location is fixed. Figure 2 describes the location based strategy for sensor network.

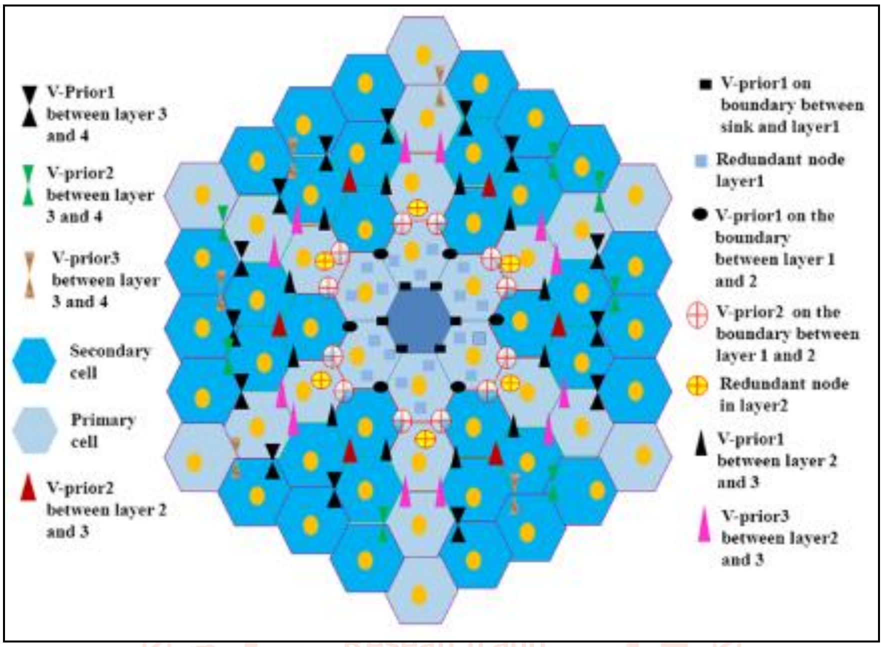

Fig 2: Location Based strategy

4. Corona-Based Strategies
A. Non- Uniform Strategies
Most of the non-uniform strategies involves co-centric circle (corona) model. Pathak et al. have used an exponential distribution of nodes towards the sink with hybrid routing to solve holes issue [12]. Olariu and Stojmenovic[13] examined the likelihood of evading energy holes by a non-uniform node distribution technique. They conclude that balanced energy consumption can be accomplished when the node density pi of the i^{th} corona is relational to (k+1-i), where k is the optimum number of coronas. Lian et al. have proposed a non-uniform technique [14] to improve data capacity of the network. Node relays are added to network to improve data received by the sink. They have also used sleep based scheduling to preserve energy in the network. Figure 3 and Figure 4 describe Non- Uniform corona strategy.

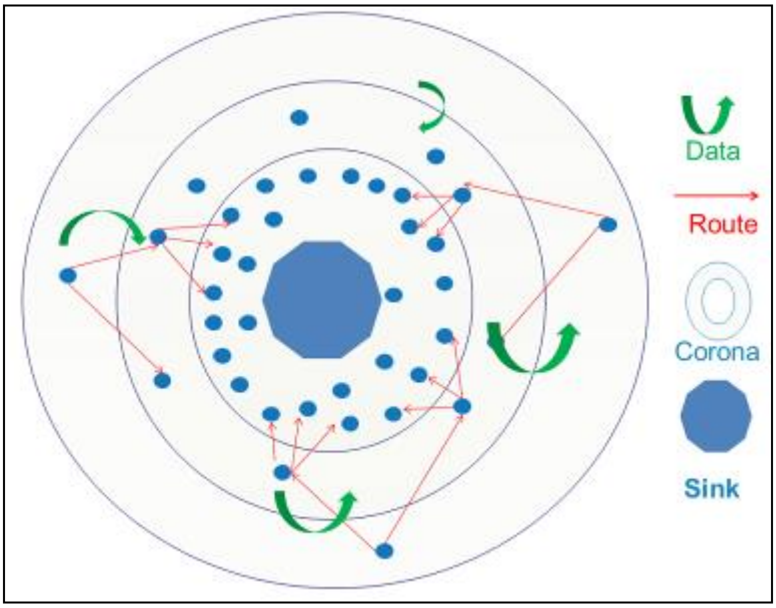

Figure 3: An instance of Non-uniform Strategy

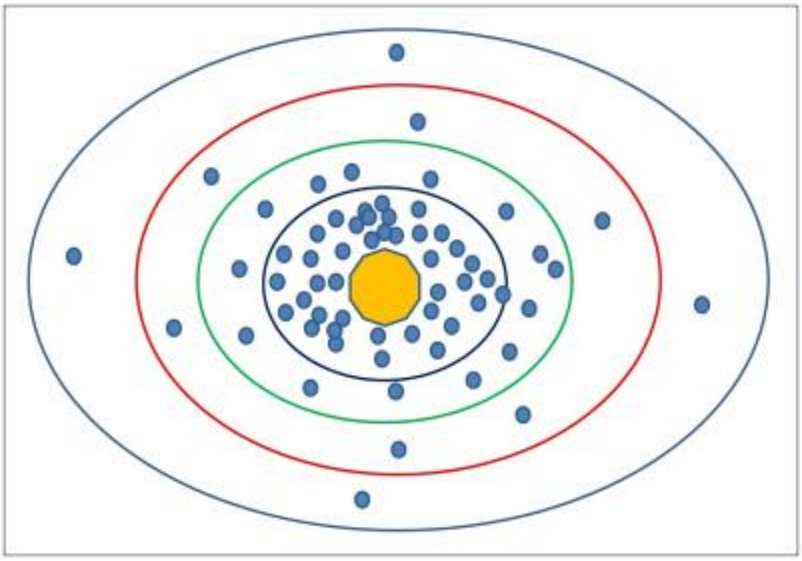

Figure 4: Engineered Based Non-uniform Strategy

B. Duty cycle based Strategy

Authors in [16] have proposed power saving E-MAC protocol which is capable of generating any duty cycle based on its traffic load. Figure 5 shows their adapted model. The authors have considered following parameters.

The sensors are arbitrarily and homogenously positioned in a circular area and the sink node has been positioned at the center of the network. The circular area has been partitioned into numerous coronas rendering to the hop count distance to the sink. The i^{th} corona is expressed by Ci, as shown in Fig. 5.

1. The sink node is constantly responsive.
2. Sensors are not time coordinated.
3. All the sensors have the similar transmission range.
4. After deployment, all sensors remain steady.
5. Sensors sporadically report accumulated data to the sink node.
6. Sensors positioned at a corona C_i depend on on those positioned at the corona $_{Ci-1}$ relaying their packets to the sink.

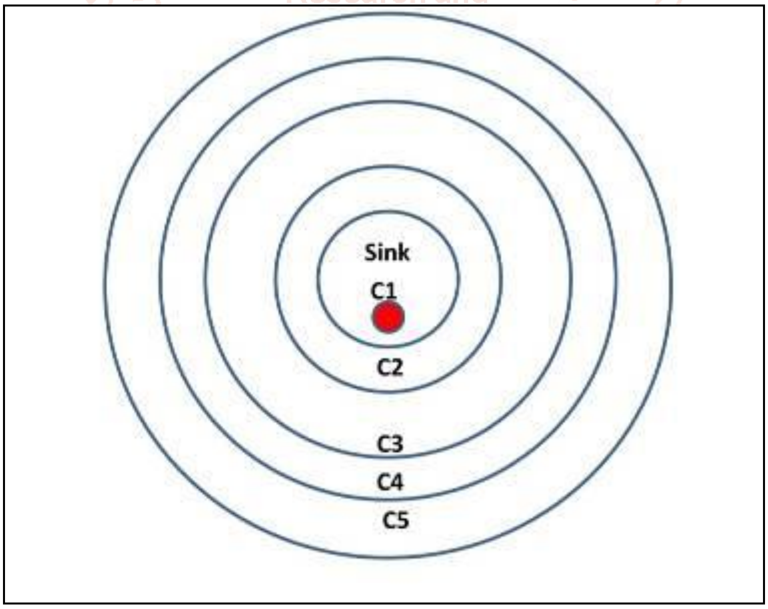

Figure 5: Corona based E-MAC model

The purpose of E-MAC is to permit all sensors to regulate its duty cycle rendering to its traffic burden and offer location surety to any pair of sensors. To accomplish these objectives, the E-MAC protocol entails of two stages: preliminary phase and active/sleep schedule stage. The preliminary phase regulates the corona in which a sensor node has been positioned. As the sporadic report prototype has been adopted, recognizing the corona a sensor node is positioned indicates its traffic load can be computed. The second stage decides the active/sleep schedule to attain the secondary objective.

C. Coalition Representative Based Corona Model

Authors in [17] have proposed coalition based corona model. The recommended method is a combination of three dissimilar stages and these are labeled as node dissemination, coalition and network data renewal. The node dissemination stage positions the sensors non-uniformly across the network to evade the creation of energy holes. In subsequent stage, a voting process has been suggested to select a coalition representative (CR) within separate coronas. The vote function is received from remaining energy and spatial correlation feature among the sensors. Additional, all CRs makes a coalition and the CR conveys their self-sensed data to the sink on behalf of a coalition. The CR communes its data to the sink through multi-hop routing. Coalitions have been to decrease the number of transmissions in the network which extends the network function. Conclusively, a matrix completion centered technique has been employed at the sink to rebuild the data of the whole network. The simulation outcomes for the suggested method settle that energy effective WSN is attained when compared with prevailing methods. Figure 6 defines the corona distribution ideas of the suggested prototype.

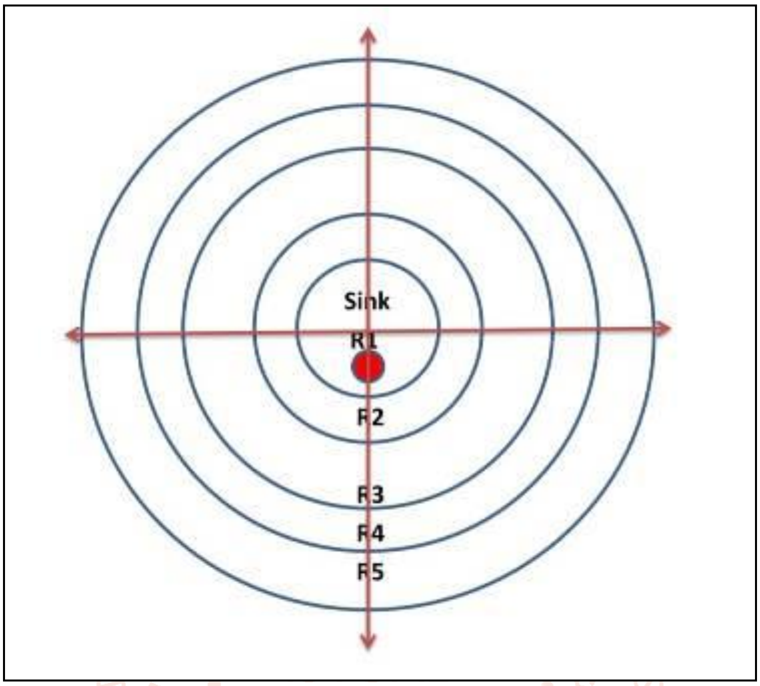

Figure 6: Coalition Representative Based Corona Model

The deployed sensors are stationary, homogeneous; untouched after deployment, contain of distinctive node identity, and preserve similar initial energy and stops once its battery has been depleted. All sensors have a sensing range of R_S and the transmission range of R_T. Two sensors converse with each other if they stay within their transmission range. The sensing and the data transmission by all sensors have been done sporadically. The authors have considered corona-based network architecture in which the whole network area M X M has been divided into a concentric circles or coronas of uniform width R as expressed in Fig. 6. Henceforth, the region of the innermost corona is found as $A = \pi r^2$ and the likely number of coronas N is M/2R. In the considered network architecture the area of coronas from innermost to outermost follows a cumulative arithmetic progression pattern with common variance of 2 πr^2.

Conclusions

This paper reviews corona and non-corona based strategies used for reducing energy holes problem in wireless sensor networks. It has been concluded that among all corona based techniques Non-uniform distribution strategy has been most effective technique. However any of the technique is not capable to completely removing the holes from the network. A significant contribution of E-MAC is that it can produce any duty cycle and reduces redundant energy depletion. Simulation outcomes validate that E-MAC expressively overtakes other MAC protocols in terms of duty cycle gap, network lifetime, delay violation ratio, and throughput.

REFERENCES

[1] Rohini Sharma, D. K. Lobiyal, "Energy Based Proficiency Analysis of Ad-hoc Routing Protocols in Wireless Sensor Networks", IEEE Conference Proceedings ICACEA, March 2015, pp. 882-886.

[2] Rohini Sharma, D. K. Lobiyal, Intelligent Water Drop Based Coverage- Connectivity and Lifespan Maximization Protocol for Wireless Sensor Networks, Recent Patents on Computer Science, 2018.

[3] Rohini Sharma, Energy Holes Avoiding Techniques in Sensor Networks: A survey, Pages: 204-208, International Journal of Engineering Trends and Technology, Vol. 20, no. 4, 2015.

[4] W. B. Heinzelman, A. P. Chandrakasan, and H. Balakrishnan, "Energy-efficient communication protocol for wireless microsensor networks," in Proc. of the 33rd Hawaii International Conference on system sciences(HICSS), January 2000.

[5] M. B. Rasheed, N. Javaid, Z. A. Khan, U. Qasim and M. Ishfaq, "E-HORM: An Energy Efficient Hole Removing Mechanism in Wireless Sensor Networks," in 26th IEEE Canadian Conference on Electrical and Computer Engineering (CCECE), 2013.

[6] X. Wu, G. Chen, and S.K Das, "On the Energy Hole Problem of Nonuniform Node Distribution in Wireless Sensor Networks," in Proc. Mobile Adhoc and Sensor Systems (MASS), IEEE 2006 ,pp. 180-187.

[7] X. Wu, G. Chen, and S. K. Das, "Avoiding energy holes in wireless sensor networks with nonuniform node distribution," IEEE Trans. Parall. Distrib. Sys., vol. 19, pp.710-720, May 2008.

[8] G. Ma, and Z. Tao, "A Nonuniform Sensor Distribution Strategy for Avoiding Energy Holes in Wireless Sensor Networks," Int. J. Distrib. Sens. Netw. vol. 2013, Article ID 564386, 14 pages, 2013.

[9] X. Zhang, Z. Da Wu, "The balance of routing energy consumption in wireless sensor networks," J. Parallel Distrib. Comput., vol 71, pp.1024-1033, April 2011.

[10] S. Halder, A. Ghosal, S. Sur, A. Dan, and S. DasBit, "A lifetime Enhancing Node Deployment Strategy in WSN," LNCS, Springer-Verlag, pp. 295-307, 2009.

[11] Pathak, Zaheeruddin, D. K. Lobiyal, " Maximization the lifetime of wireless sensor network by minimizing energy hole problem with exponential node distribution and hybrid routing," IEEE, Engineering and Systems (SCES), Students Conference, march 2012, pp. 1-5.

[12] 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," in IEEE International Conference on Broadband and Wireless Computing, Communication and Applications (BWCCA), Oct. 2013, pp.164-169.

[13] S. Olariu and I. Stojmenovic, "Design Guidelines for Maximizing Lifetime and Avoiding Energy Holes in Sensor Networks with Uniform Distribution and Uniform Reporting," in Proc. IEEE INFOCOM' April 2006, pp. 1-12.

[14] J. Lian, K. Naik, and G. Agnew," Data capacity Improvement of wireless sensor networks using Non-uniform sensor distribution," Int. J. Distrib. Sens. Netw., vol. 2, pp.121-145, June 2006.

[15] Chih-Min Chao and Cheng-Hong Jiang, Energy Efficient Protocol for Corona-Based Wireless Sensor Network, 2018 19th IEEE/ACIS International Conference on Software Engineering, Artificial Intelligence, Networking and Parallel/Distributed Computing (SNPD), June 27-29, 2018, Busan, Korea.

[16] Vivekanand Jha, Nupur Prakash and Shekhar Verma, An Energy Efficient Approach for Corona based Wireless Sensor Network, Ubiquitous Computing, Electronics and Mobile Communication Conference (UEMCON), 2017 IEEE 8th AnnualAt: New York City, NY, USA, USA.