International Journal of Advance Research in Science and Engineering
Vol. No.4, Issue 08, August 2015
www.ijarse.com
IJARSE
ISSN 2319 - 8354

COMPARISON OF GEOGRAPHIC ROUTING PROTOCOLS IN WIRELESS SENSOR NETWORKS-A REVIEW

Payal Walia[1], Anuj Mehta[2]

[1,2] *Computer Science and Engineering, S.K.I.E.T (K.U.K), (India)*

ABSTRACT

Geographic routing protocols are utilized as a part of Wireless Sensor Network (WSN) in which the data about the location of nodes is utilized for correspondence. It is otherwise called location based routing or position based routing. These routing protocols reduce the energy utilization and expand the lifetime of the system. This paper gives a comparison about geographic based routing furthermore examination of some critical area based routing protocols GEAR, GAF, LAR. For better comprehension, the correlation between these geographic routing protocols is shown: GAF, GEAR, and LAR.

Keywords: Energy Efficiency, Geographic Routing Protocols, Wireless Sensor Networks.

I. INTRODUCTION

A WSN is a network of gadgets that is known as nodes. The nodes sense the earth and afterward impart the gathered data to different hubs by means of remote connection. The sensor hubs first sense and afterward handle the information. On the off chance that the destination node is not a neighbor hub then the information must be gone through various jumps to a sink node that is otherwise called controller. The sink node goes about as an extension in the middle of client and the Internet. A client can gather data by asking the inquiries and gathering the reaction from sink hub. The nodes that are utilized to send the information may be settled or portable.

A sensor node was delivered in North America. A sensor node generally called a "bit". It is a node in a wireless sensor network that is prepared for performing some planning, gathering material information and comparing with other joined nodes in the network. A bit is a node however a node is not for the most part a bit. There are two sorts of sensor nodes used as a piece of the WSN. One is the normal sensor node passed on to sense the phenomena and the other is section node that interfaces sensor network to the external world. The major basic arranging of sensor node consolidates taking after parts: Controller module, Memory module, Communication module, Sensing modules, Power supply module as exhibited in Fig.1 & Fig.2 demonstrates the three-level WSN architecture.

International Journal of Advance Research in Science and Engineering
Vol. No.4, Issue 08, August 2015
www.ijarse.com
IJARSE
ISSN 2319 - 8354

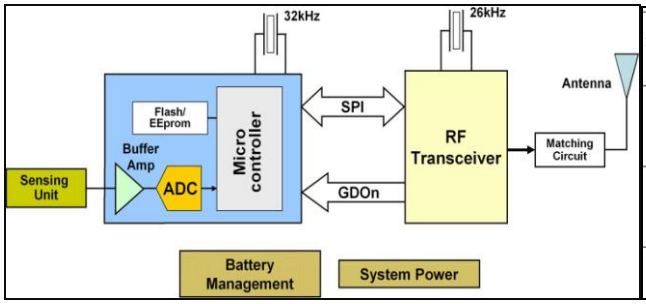

Figure1: Sensor Node Architecture

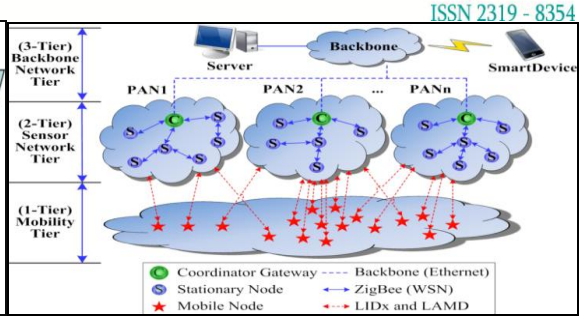

Figure2: Three-Tier WSN Architecture

Detecting or sensing units are by and large made out of two subunits: Sensors, Analog-to-Digital (computerized) converters (ADCs).

Geographic routing is taking into account the position of nodes as opposed to its network address. In this, a source node knows the geographic area of the destination and makes an impression on the destination consequently is otherwise called geographic routing. Nodes don't have the worldwide data of whole network means the global information of network. It doesn't oblige flooding and thus diminishes the control overhead. It just knows the area of its immediate neighbors to forward the bundle. Route discovery is in light of the area data & once the course is manufacture then the bundle is forward. Area of the nodes is accessible through different techniques like GPS, radio signal quality i.e. received radio signal strength (RSSI) and so forth. GPS (Global Positioning System) can be utilized to get the area data straightforwardly through satellite. The separation between the neighboring nodes can be evaluated on the premise of approaching sign qualities and by trading such data between neighbors, relative directions of the neighboring nodes can be obtained. Utilizing the area data, the destination region is selected and the packet is sent to that selected region [2]. This scheme overcomes the issue of limited power in WSN as in some schemes nodes enters into the sleep mode when they are not in used. Energy saving depends upon the number of dozing nodes in the network. A few points of interest and disservices of geographic routing are specified underneath. There are different sorts of geographic routing protocols in wireless sensor networks with each having a different feature of its own. Some of them are given as follows: MECN - Minimum Energy Communication Network, GPSR - Greedy Perimeter Stateless Routing Protocol, SMECN - Small Minimum Energy Communication Network, GEAR - Geographic Energy Aware Routing, GAF - Geographic Adaptive Fidelity, LAR – Location Aided Routing, GOAFR - The Greedy Other Adaptive Face Routing, TBF - Trajectory Based Forwarding, and SPAN- Coordination of Power Saving with Routing.

From the above mentioned location based routing protocols. This paper shows the brief study of the three location based routing protocols as GAF, GEAR and LAR.

Advantages

1. It reduces control overhead as this scheme does not require flooding.
2. It saves the energy consumption through various techniques.
3. The cost of route setup is reduced as it is based on the location of destination.
4. It requires less memory as there is no need to store the entire network information.
5. It is scalable i.e. any number of nodes can join the network.
6. It also needs less maintenance.

Disadvantages

1. If the destination node lies in same region then the same old path is being followed, it leads to more power usage for specific nodes and some remained underutilized.

II. RELATED WORK

Constrained Energy is a significant issue in remote sensor systems. This significantly influences the execution of the system. Vitality effectiveness is the most difficult issue in the exploration zone in the field of WSNs. This section will audit the different vitality productive plans proposed by diverse creators to enhance the system execution.

In [6], creators accomplish vitality effectiveness by streamlining the radio scope of hub. This paper dissects a 2-D specially appointed remote system in light of GAF topology administration convention and attempted to locate the ideal transmission scope of hubs and broke down the vitality utilization by utilizing the idea of cell models in GAF. By looking at the vitality utilization results demonstrates that the flexible cell model spares 62.6% vitality in examination to the equivalent cell model. A relationship between the ideal transmission range and system movement is indicated by the assistance of tests. It demonstrates that vitality of the system can be minimized by diminishing the quantity of hubs utilized as a part of activity transmission. The division of system and selecting a fitting group head additionally influences the general execution of the system. The division of system is in view of the figuring that as indicated by the position data hub fits in with which framework. Choice of bunch head is finished by the assistance of "Expense" variable.

The node having least cost inside of the framework is chosen [7]. This proposed convention is known as DGAF (Dynamic-division Geographical Adaptive Fidelity). The essential motivation behind this calculation is to locate the ideal position of the group head. The range is isolated into frameworks as hexagons named as DGAF-6; or as squares named as DGAF-4. Results demonstrate that proposed calculation is superior to GAF as far as system lifetime and burden adjusting. In GAF, system is isolated into an equivalent size of square framework. In a square matrix structure a hub can reach to the contiguous frameworks just in vertical and even bearings yet not in corner to corner heading.

Hexagonal matrix structure (GAF-HEX) is proposed in [8] to defeat the issue of inaccessible corner of GAF. GAF-C and GAF-E are two hub mapping calculations presented for GAF-HEX. GAF-C maps the hubs with reference hub at focus and GAF-E maps the hubs with reference hub at end of framework. System Simulator NS-2.3 is utilized for demonstrating reenactment of execution assessment. GAF-HEX enhances bundle conveyance proportion and throughput and vitality utilization is verging on same as GAF.

Hierarchical Geographic Adaptive Fidelity (HGAF) is proposed to spare the force of the hubs which expands the lifetime of entire system [9]. It spares control by expanding the cell size of GAF utilizing a layered structure for selecting a dynamic hub in every cell. Result demonstrates that HGAF performs better than GAF if there should be an occurrence of vitality proficiency and parcel conveyance proportion. Likewise when there is high hub thickness and a cell is further partitioned into four sub cells then the lifetime of system is expanded 200% in HGAF examination to GAF. Assessment is performed utilizing Network Simulator NS-2.

In [10], creators proposed the augmented rendition of HGAF i.e. e-HGAF (extended HGAF) which is further enhanced to spare the vitality utilization by isolating the sensor field in an effective way and expand the lifetime

of system. This paper likewise thinks about the upper bound on the cell estimate in e-HGAF. This paper takes a shot at two ideas: Cell expansion by changing cell shape to triangle cells and Cell extension by lessening edges.

In [11], creators proposed a component for topology control named as Sensor-DMAC. It utilizes the essential tenets of DMAC. This paper likewise thinks about the execution of S-DMAC, DMAC and GAF and demonstrates that S-DMAC is more successful for giving vitality proficient courses. It additionally defeats the disadvantages of GAF. Reenactments results are demonstrated in NS2 contrasting and GAF.

Creator in [12], analyzes the execution of topology control conventions. The objective of this paper is to explore the execution by dissecting the heap appropriation and also arrange lifetime. The examination between Energy-effective coordination (SPAN) convention, Geographical Adaptive Fidelity (GAF) convention and Optimized Topology Control (OTC) convention is demonstrated.

In [13], creators dissected the current topology administration control calculations in multistate structure. This paper proposed the answer for preserve vitality and expands the lifetime of the system. The proposed calculation is in light of Geographic Adaptive Fidelity (GAF) and Adaptive Self-Configuring Sensor Networks Topology (ASCENT). The primary center is on looking the definite area of the expert hub in a network by sending test signs to every one of the hubs in a lattice. The expert hub is chosen at the focal point of the lattice and rest of the hubs enters to rest state rationing vitality. This serves to expand the lifetime of system in correlation to the conventional GAF in which hub head is chosen arbitrarily.

Authors in [14], study the advances made in Geographic Adaptive Fidelity (GAF) protocol. To diminish vitality utilization CODE protocol is proposed utilizing GAF protocol and is sent above GAF. In GAF, pointless hubs are killed while keeping a steady level of routing devotion though. For the motivation behind vitality cost lessening CODE is in light of the lattice structure to exchange information along a briefest way and also GAF to diminish utilization of vitality and information collision. Limited vitality is the most critical issue in remote sensor system. Subsequently, numerous steering conventions have been intended to preserve the vitality of the sensor hubs. In [15], creators contemplated a rundown of Energy Efficient Routing (EER) conventions with their focal points and impediments. This paper additionally assessed the execution of these conventions on the premise of distinctive parameters, for example, versatility, vitality productivity, lifetime, information collection and additional overhead. To build the lifetime of system by bringing down the obligation cycle of every hub a convention known as Sleep Doze Coordination (SDC) is proposed [16]. This uses a layered building design of remote sensor system. Every layer is broken into lattices like GAF. As per SDC, there are two modes at every hub:

a) “On” period {Alert mode or Doze mode}
b) “Off” period {Sleep mode}

Unmoving listening state is known as nap state. One hub for every network is in "snooze" state for a predefined time and rests are in rest state. A hub in the snooze state goes into a dynamic state when hub cradle gets filled to its ability by information messages from the lower layer. The system is actualized in NS2 test system. SDC expands system lifetime by roughly 20% over GAF protocol.

International Journal of Advance Research in Science and Engineering
Vol. No.4, Issue 08, August 2015
www.ijarse.com
IJARSE
ISSN 2319 - 8354

III. ROUTING PROTOCOLS IN WIRELESS SENSOR NETWORKS

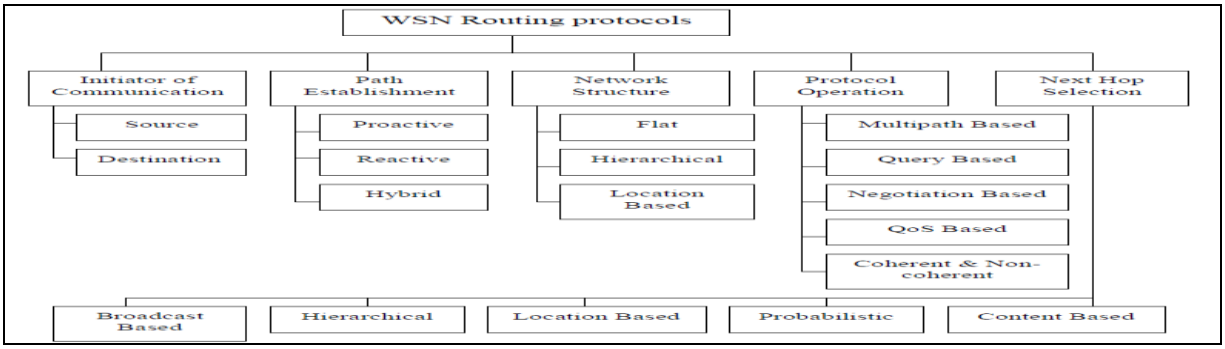

Figure 3: Classification of Routing Protocols in WSNs

3.1 Geographic Routing: Geographic routing [2] [3] utilizes area data to figure a proficient course look toward the destination. Geographic routing is exceptionally suitable to sensor systems, where information collection is a helpful procedure to minimize the quantity of transmissions toward the base station by taking out excess among parcels from the distinctive sources. [1]It is much appealing for extensive multi-jump remote systems in which the hubs are not dependable and their system topology is as often as possible evolving. Topographical steering (routing) just requires the proliferation of single jump topology data, similar to the best neighbor, to settle on right sending choices. Its confined methodology lessens the need of keeping up steering tables, and subsequently decreases the control overhead. It doesn't oblige flooding. Just hubs that exist in the assigned sending zone are permitted to forward the information bundle. The sending district can be characterized by the source hub or by the transitional hubs to avoid hubs that may bring about a temporary route while sending the information bundle. The second property of land directing is its position based steering. Here a hub obliges knowing just the area data of its immediate neighbor. The system utilized is covetous instrument where every hub advances a parcel to the neighboring hub that is nearest to the destination. The Euclidean separation to the destination is for the most part utilized as metric. Position based steering conventions can possibly diminish control overhead and decrease vitality, as flooding for hub disclosure and state engendering are limited to inside of a solitary jump [1]. The system thickness, the precise restriction of hubs and the sending principle chooses the effectiveness of the plan.

Advantages of geographic routing

1. The versatility backing can be encouraged. Since every hub sends its directions intermittently, every one of its neighbors redesign their steering tables as needs be. In this manner all hubs mindful of its alive neighbor hubs.
2. It is adaptable. The measure of steering table relies on upon system thickness not on system populace. Thus more extensive systems comprising of a large number of hubs can be acknowledged without bunch arrangement.
3. Minimum overheads are presented. The main data required is the area of neighbors. Just limited cooperation occurs. Subsequently data transfer capacity is streamlined. The handling and transmission vitality is spared and the measurements of steering table are diminished.

3.2 Geographic (Location) Based Protocols: In location or geographic based protocols [1], sensor nodes are basically tended to by their method for areas. In sensor systems, location information for nodes is important.

3.2.1 Geographic Adaptive Fidelity (GAF): Geographic based routing is a location based protocol which is energy conservative. GAF is a kind of protocol which was proposed principally for MANETS and later it was utilized for wireless sensor networks also. The framework of GAF is engaged around the energy display that contains energy utilization amid the transmission and gathering of bundles and in addition amid unmoving time. In GAF the sensor field will be isolated into lattice or grid squares, every sensor utilizes its area data to connect with different matrices. This area data will be given by GPS or by other area frameworks. Fig.4 State Transition Diagram for GAF State move outline of GAF comprises of three states. They are dynamic, rest and disclosure. In resting state sensor will kill its radio wire for vitality reserve funds. In disclosure express a sensor exchanges trade messages to investigate different sensors in the same cross section. Indeed, even in the dynamic express the sensor incidentally demonstrates its disclosure message to illuminate proportionate sensors about its state. The time utilized as a part of each of the state will be contingent on couple of segments like its needs and sensor portability. GAF intends to grow the system lifetime by landing at a state where every lattice contains one dynamic sensor concentrated around sensor positioning standards. The most elevated rank will handle directing inside of their individual lattices.

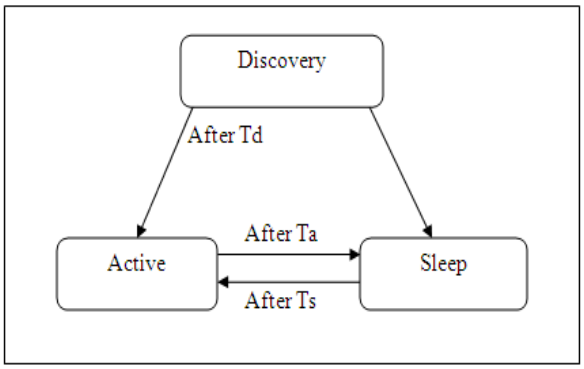

Figure 4: Transition States in GAF

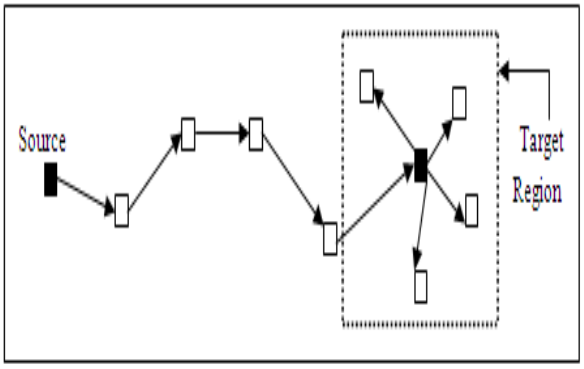

Figure 5: Gear Network

3.2.2 Geographic and Energy-Aware Routing (GEAR): GEAR is an energy productive protocol proposed for routing inquiries to focus on the areas in the sensor field as shown in Fig.5. The sensors will be outfitted with limitation equipment like GPS, confinement framework. With the assistance of this the sensors can think about their present positions. The sensors can think about its area, their lingering energy and neighbors as well. Keeping in mind the end goal to choose the sensors to course the bundle towards destination it utilizes energy efficient techniques utilizing topographical data. By then GEAR utilizes recursive geographic sending to spread the bundles inside the objective area.

3.2.3 Location Aided Routing (LAR): LAR utilizes the Global Positioning System (GPS) to acquire the location information of a node. LAR basically describes how location information, for example, GPS can be utilized to diminish the routing overhead in a wireless sensor network and guarantee maximum connectivity. Location Aided Routing is a example of restricted directional flooding routing protocol that spares extensive data transfer capacity and leaves those nodes that are not between the source and destination untouched which saves the energy of these unwanted nodes that are not in the path of destination node. The range of network in which current area of destination is relied upon to be is known as "expected zone" and the zone through which ask for bundle needs to travel is called as "solicitation zone" or request zone as shown in Fig.6. By utilizing area data,

the Location-Aided Routing (LAR) protocols confine the quest for another course to a littler "solicitation zone" of the system subsequently lessening utilization of energy by nodes and improve the lifetime of network.

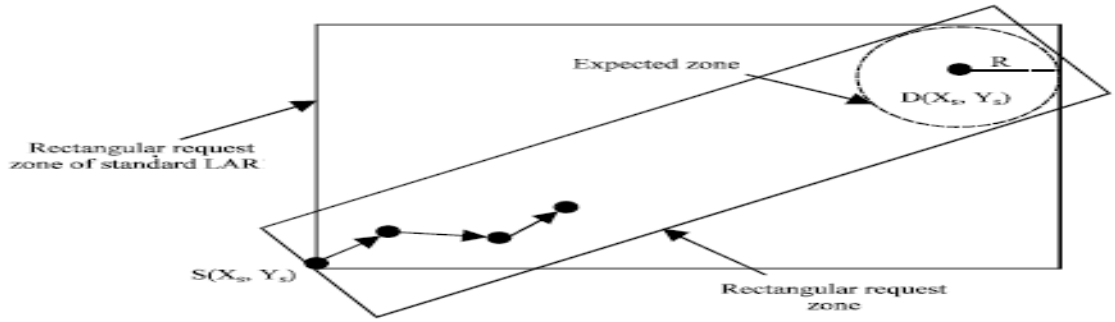

Figure 6: LAR Request & Expected Zone

IV. COMPARISON BETWEEN GEOGRAPHIC ROUTING PROTOCOLS

There are various routing protocols [36] exist in the wireless sensor network. Each protocol has its own features which makes them different from others. But geographic routing is better technique over the others. It reduces the overhead and makes the network faster as compare to non-geographical protocols. Geographic routing protocols can work on flat as well as hierarchical topology. On the basis of above explanations, analysis of the geographic routing protocol is being done. Table 1 shows the basic comparison of GAF, GEAR and LAR on the basis of different factors i.e. Latency, scalability, connectivity adaptation, energy awareness, Quality of Service (QOS), Traffic on network, power usage and transmission scheme used.

Table 1: Comparative Analysis of Various Geographic Routing Protocols

Geographic Routing Protocol	Data Delivery Model	QOS	Power Usage	Scalability	Overhead	Data Aggregation	Query Based	Advantages	Disadvantages
GAF	Virtual grid	No	Ltd	Good	Moderate	No	No	Optimize the performance of WSN. Highly Scalable. Maximize the network lifetime. Limited energy conservation.	High overhead. Doesn't take care of QOS during data transmission. Limited mobility. Limited power management.

GEAR	Demand driven	NO	Ltd	Ltd	Moderate	No	No	Increase the Network lifetime. Reduces Energy Consumption.	Limited Scalability. Limited Mobility. Limited Power management. High overhead Doesn't take care of QOS.
LAR	Restricted directional flooding	NO	Ltd.	Ltd	Moderate	Yes	No	Reduces the energy consumption of nodes. Less over head Supports data aggregation.	Scalability is limited. No QOS.

V. APPLICATIONS OF GEOGRAPHIC ROUTING

Wireless sensor network is used in various applications [5] depending upon the requirements of the application. This paper highlights the use of geographic based protocols in various applications. Every application needs some basic requirements to be fulfilled. On the basis of these requirements, a protocol is being selected. Table 2 shows some geographic based protocols used in different areas. Varieties of applications are shown with respect to different areas. Difference in applications is on the basis of various factors such as environment, performance, security and quality of service provided by them.

Table 2: Applications of Geographic Routing

Area	Applications	Protocols
Military	Recognition missionObject tracking Intrusion detectionCriminal hunting	GAF MECN SMECN LAR
Commerce	Meetings Extension of cellular networks Conferences	MECN SMECN
Environment	Physical world surveillance Emergency situation surveillance	GAF GEAR MECN GOAFR
Home	Home automation Gaming Entertainment	GEAR GOAFR
Automotive	For traffic decongestion For driving safety For avoiding accident areas	GPSR LAR

VI. CONCLUSION & FUTURE SCOPE

In WSNs, there are numerous requirements which influence its utilization in different applications. A long lifetime of the network is critical for good results. This paper investigated that protocols of geographic method can give preferred results over non-geographic. As these are in view of area data, it spares a great deal of energy furthermore build the lifetime of network. Location information can be acquired through different techniques like GPS, GIS and so forth. Location based protocols can be utilized with level and in addition various leveled topologies. Although there are numerous geographic based routing protocols exist with an alternate working however the fundamental point of these protocols is to spare energy. This paper demonstrates the examination of three location based protocols i.e. GAF, GEAR, LAR.

REFERENCES

[1] G. Nivetha, "Energy optimization routing techniques in Wireless Sensor Networks", International Journal of Advanced Research in Computer Science and Software Engineering, ISSN: 2277-128X, Volume 2, Issue 7, pp. 344-348, July 2012.

[2] Shio Kumar Singh, M P Singh and D K Singh, "Routing protocols in Wireless Sensor Networks - A Survey", International Journal of Computer Science and Engineering Survey, DOI : 10.5121/ijcses.2010.1206, Volume 1, No.2, pp. 63 - 83, November 2010.

[3] Rajashree V. Biradar, V. C. Patil, S. R. Sawant and R.R. Mudholka, "Classification and Comparison of Routing Protocols in Wireless Sensor Networks", Special issue on Ubiquitous Computing Security Systems, UbiCC Journal, Volume 4, pp. 704-711.

[4] Vandana Jindal, A.K.Verma and Seema Bawa, "How the two Adhoc networks can be different: MANET & WSNs", International Journal of Computer Science & Technology (IJCST), ISSN: 0976-8491 (Online), ISSN: 2229-4333(Print), Volume 2, Issue 4, pp.122-126, Oct-Dec. 2011.

[5] Th. Arampatzis, J. Lygeros, and S. Manesis, "A Survey of Applications of Wireless Sensors and Wireless Sensor Networks", IEEE International Symposium on Intelligent Control, ISSN: 2158-9860, DOI: 10.1109/.2005.1467103, pp. 719-724, June 2005.

[6] Wei Feng, Shihang Li and Lin Zhang, "Energy Efficiency: Optimal Transmission Range with Topology Management in 2-D Ad-hoc Wireless Networks", International Conference on Computer Networks and Communication Systems (CNCS 2012), Accession: 83362725, Volume 35, pp. 26-31.

[7] QI Xiao-gang and QIU Chen-xi, "An Improvement of GAF for Lifetime Elongation in Wireless Sensor Networks", 5th IEEE International Conference on Wireless Communications, Networking and Mobile Computing, DOI: 10.1109/WICOM.2009.5303049, pp. 1- 4, Sept. 2009.

[8] Ankita K. Patel and Radhika D. Joshi, "Energy Conservation for Wireless Mobile Ad hoc Networks using Hexagonal GAF Protocol", Recent Advances in Networking, VLSI and Signal Processing, ISSN: 1790-5117, pp. 29-34.

[9] Tokuya Inagaki and Susumu Ishihara, "HGAF: A Power Saving Scheme for Wireless Sensor Networks", IPSJ Journal, Volume 50, No. 10, pp. 2520-2531, Oct. 2009.

[10] Susumu Matsumae and Fukuhito Ooshita, "Hierarchical Low Power Consumption Technique with Location Information for Sensor Networks", International Journal of Advanced Computer Science and Applications (IJACSA), DOI: 10.14569/IJACSA.2013.040412, Volume 4, No. 4, pp. 69-74, Dec 2013.

[11] Stefano Basagni, Alessio Carosi, and Chiara Petrioli, "Sensor-DMAC: Dynamic Topology Control for Wireless Sensor Networks", 60th IEEE Conference on Vehicular Technology, ISSN : 1090-3038, DOI: 10.1109/VETECF.2004.1400597, Volume 4, pp. 2930 - 2935, Sept. 2004.

[12] Ababneh N, "Evaluation of On/Off scheduling protocols for ad hoc and sensor networks", IEEE International Conference on Wireless Communications, Networking and Information Security (WCNIS), DOI: 10.1109/WCINS.2010.5544122, pp. 419 - 423, June 2010.

[13] Abrar Alajlan, Benjamin Dasari, Zyad Nossire, Khaled Elleithy and Varun Pande, "Topology Management in Wireless Sensor Networks: Multi-State Algorithms", International Journal of Wireless & Mobile Networks (IJWMN), DOI:10.5121/ijwmn.2012.4602, Volume 4, No. 6, pp. 17-25, December 2012.

[14] Pallavi Jindal and Vikas Gupta, "Study of Energy Efficient Routing Protocols of Wireless Sensor Networks and Their Further Researches: a Survey", International Journal of Computer Science and Communication Engineering, ISSN 2319-7080, Volume 2, Issue 2, pp. 57-62, May 2013.

[15] Md. Atiqur Rahman, Shahed Anwar, Md. Ileas Pramanik and Md. Ferdous Rahman, "A Survey on Energy Efficient Routing Techniques in Wireless Sensor Network", IEEE International Conference on Advanced Communication Technology (ICACT), ISSN : 1738-9445, pp. 200-205, Jan 2013.

[16] Arpan Roy, Adway Mitra, Arijit Khan, and Debashis Saha, " Buffering Techniques in Sleep Doze Coordination and Grid Based Clustering Protocols as Power Management Schemes for Wireless Sensor Networks", IEEE International Conference on Wireless, Mobile and Multimedia Networks, ISSN: 0537-9989, pp. 240 - 245, Jan 2008.

[17] Guofang Nan, Guanxiong Shi, Zhifei Mao and Minqiang Li, "CDSWS: Coverage-Guaranteed Distributed Sleep/ Wake Scheduling For Wireless Sensor Networks", EURASIP Journal on Wireless Communications and Networking, DOI: 10.1186/1687-1499-2012-44, Online ISSN: 1687-1499, February 2012.

[18] Q. Gao, K. J. Blow, D. J. Holding, I. W. Marshall and X. Peng, "Routing Analysis and Energy Efficiency in Wireless Sensor Networks", Proceedings of IEEE International Symposium on Circuits and Systems (ISCAS), DOI: 10.1109/CASSET.2004.1321943, Volume 2, pp. 533-536, June 2004.

[19] Hung Le Xuan, Dae Hong Seo, Sungyoung Lee, and Young-Koo Lee, "Minimum-Energy Data Dissemination in Coordination-based Sensor Networks", 11th IEEE International Conference on Embedded and Real-Time Computing Systems and Applications, ISSN: 1533-2306, DOI: 10.1109/RTCSA.2005.58, pp. 381- 386, Aug. 2005.

[20] Arpan Roy, Adway Mitra, Arijit Khan, Mita Nasipuri and Debashis Saha, "LSDC A Lossless Approach to Lifetime Maximization in Wireless Sensor Networks", IEEE Sensors Applications Symposium (SAS), pp. 166-171, Feb. 2008.

[21] Ibukunola. A. Modupe, Oludayo. O. Olugbara and Abiodun. Modupe, "Minimizing Energy Consumption in Wireless Ad hoc Networks with Meta heuristics", The 4th International Conference on Ambient Systems, Networks and Technologies (ANT 2013), DOI: 10.1016/j.procs.2013.06.019, pp. 106-115, 2013.

[22] Ridha Soua and Pascale Minet, "A Survey on Energy Efficient Techniques in Wireless Sensor Networks", IEEE Wireless and Mobile Networking Conference (WMNC), DOI: 10.1109/WMNC.2011.6097244, pp. 1-9, Oct 2011.

[23] Ibukunola A. Modupe, Oludayo O. Olugbara, Sunday O. Ojo and Abiodun Modupe, "Experimental Comparison of Genetic Algorithm and Ant Colony Optimization to Minimize Energy in Ad-hoc Wireless Networks", Proceedings of the World Congress on Engineering and Computer Science (WCECS), ISSN: 2078-0958 (Print), ISSN: 2078-0966 (Online), Volume 2, October 2013.

[24] Jenn-Wei Lin and Shih-Chieh Tang, "Coverage Improvement for Target Tracking in Hybrid Sensor Networks", IEEE International Conference on Computer and Automation Engineering (ICCAE), DOI: 10.1109/ICCAE.2010.5451768, Volume 4, pp. 126-130, Feb. 2010.

[25] Jiaxi You, Dominik Lieckfeldt, Jakob Salzmann and Dirk Timmermann, "GAF&Co: Connectivity Aware Topology Management for Sensor Network", IEEE 20th International Symposium on Personal, Indoor and Mobile Radio Communications, DOI: 10.1109/PIMRC.2009.5449817, pp. 2260 - 2264, Sept. 2009.

[26] Khushbu Babbar, Kusum Lata Jain and Manali Singh, "Survey on Coverage and Energy Consumption Problem in Wireless Sensor Network", Proceedings of 5th IACEECE, Volume 1, Issue 7, pp. 50-53, September 2013.

[27] Chi-Tsun Cheng, Chi K. Tse, and Francis C. M. Lau, "An Energy-Aware Scheduling Scheme for Wireless Sensor Networks", IEEE Transactions on Vehicular Technology, ISSN: 0018-9545, DOI: 10.1109/TVT.2010.2054842, Volume 59, Issue 7, pp. 3427 - 3444, September 2010.

[28] Robert Akl and Uttara Sawant, "Grid-based Coordinated Routing in Wireless Sensor Networks", IEEE Consumer Communications and Networking Conference (CCNC), DOI: 10.1109/CCNC.2007.174, pp. 860-864, Jan 2007.

[29] Ya Xu, John Heidemann and Deborah Estrin, "Geography-informed Energy Conservation for Ad Hoc Routing", Seventh Annual ACM/IEEE International Conference on Mobile Computing and Networking, pp. 70-84, July 2001.

[30] Adel Gaafar A.Elrahim, Hussein A.Elsayed, Salwa El Ramly and Magdy M. Ibrahim, "An Energy Aware WSN Geographic Routing Protocol", Universal Journal of Computer Science and Engineering Technology, ISSN: 2219-2158, Volume 1, Issue 2, pp. 105-111, Nov. 2010.

[31] Leily A.Bakhtiar and Somayyeh Jafarali Jassbi, "GAFBone: A New Backbone Construction for Increasing Lifetime in Wireless Sensor Networks", I.J. Computer Network and Information Security, DOI: 10.5815/ijcnis.2014.06.03, Volume 6, pp. 18-24, May 2014.

[32] Parul Bakaraniya and Sheetal Mehta, "Features of WSN and Various Routing Techniques for WSN: A Survey", IJRET, ISSN: 2319 – 1163, Volume 1, Issue 3, pp. 348-354, Nov 2012.

[33] Jamal N. Al-Karaki and Ahmed E. Kamal, "Routing Techniques in Wireless Sensor Networks: A Survey", IEEE Conference on Wireless Communications, PP. 6-28, December 2004.

[34] Sinchan Roychowdhury and Chiranjib Patra, "Geographic Adaptive Fidelity and Geographic Energy Aware Routing in Ad Hoc Routing", Special Issue of International Journal of Computer and Communication Technology (IJCCT), Volume 1, Issue 2, pp. 309-313, August 2010.

[35] Gayatri Prajapati, Palak Parmar, "A Survey on Routing Protocols of Location Aware and Data Centric Routing Protocols in Wireless Sensor Network", International Journal of Science and Research (IJSR), India, Online ISSN: 2319-7064, Volume 2 Issue 1, pp. 128-133, January 2013.

[36] Parul Tyagi and Surbhi Jain, "Comparative Study of Routing Protocols in Wireless Sensor Network", International Journal of Advanced Research in Computer Science and Software Engineering Research Paper, Volume 2, Issue 9, September 2012.

[37] N.K Prema, and Arul Lawrence Selvakumar, "Analyze the Open Research Issues in Routing Techniques for Wireless Sensor Networks", International Journal of Recent Scientific Research, ISSN: 0976-3031, Volume 5, Issue, 1, pp.236-251, January 2014.

[38] Vivek Nikam, Prof. G.T. Chavan, "Survey on Location Based Routing Protocols in MANET", (IJCSIT) International Journal of Computer Science and Information Technologies, ISSN: 0975-9646 Vol. 5 (2) , 2014, 1659-1663.