ISSN: 2349-7300
ISO 9001:2008 Certified
International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences (IJIRMPS)
Volume 2, Issue 5, October 2014

SPIN Triangulation Algorithm for energy efficient Wireless Sensor Networks on 2D Surface

Sama Nasrat, Neelesh Gupta
PG Student, HOD E.C-TIEIT

Abstract – Small sensors micro modules having capabilities of sensing, computation and wireless communication are used to form a wireless sensor network (WSN). The life of a sensor micro module depends upon its energy consumption. Therefore, energy saving and enhancement of network life are main challenges of wireless sensor network. Routing protocols are used to save energy during transmission in WSN. In this paper it is presented, how SPIN protocol, efficiently and effectively disseminate information among various sensors in an energy constrained WSN. SPIN Triangulation serves as the basis for much geometry based algorithms in wireless sensor networks. In this paper we propose SPIN Triangulation algorithm that produces a triangulation for an arbitrary sensor network, with no constraints on communication model or granularity of the triangulation. We prove its correctness in 2D, open and closed surfaces. Our simulation results show that the proposed algorithms can tolerate distance measurement errors, and thus work well under practical sensor network settings and effectively promote the performance a range of applications that depend on triangulations and energy efficiency approach.

KEYWORDS – **Energy Efficiency, Networks Lifetime, M-SPIN, Routing Protocols, SPIN, and WSN.**

I. INTRODUCTION

Efficient design and implementation of wireless sensor networks has become a interesting and important area of research in recent years, because the vast potential of sensor networks to enable applications that connect the physical world to the virtual world. Thus an optimal network is needed for the maximum utilities of processing power. Technological advance has brought the opportunity to develop and use sensor devices with very small dimensions, low consumption and processing power. Generally a Wireless Sensor Network (WSN) is consist of a large number of wireless sensor micro modules with low processing power and energy consumption for monitoring a certain environment. The large number of micro modules and their random placement in space offers great redundancy and obtain data about physical phenomena in data transmission. Its application exists in various fields including, industrial machine monitoring, surveillance, military operations, medical monitoring, home security and environmental monitoring etc.

II. ARCHITECTURE OF WSN

The architecture of WSN differs for each individual sensor micro module and depends on its entire network. Energy efficiency, size reduction and minimum cost are the main factors determine sensor micro module architecture. A wireless sensor micro module or micro module is also called as mote and consist of four functional components: sensing unit, processing unit, transceiver, and power unit. The structural block diagram of a sensor micro module is shown by the figure I [1].

1) Sensing Unit

It consists of a consist of sensors that can measure the physical characteristics of its environment.

2) Processing Unit

A microcontroller processes information and controls the working of other parts in the sensor micro module. a microcontroller is should be less expensive, ease to attach other devices, simplicity of programming, and low power utilization. Memory requirements depend on application type.

3) Transceiver

Messages are sending and receive wirelessly by transceiver. Combination of transmitter and receiver into a single device is known as a transceiver. A transceiver must have an optimal balance between a low data rate and small energy consumptions. To live for an extended period of time.

4) Power source

Power source provide energy to all component of WSN. Changing the battery regularly can be expensive and problematic. Sensing, communicating and data processing need power consumption in sensor micro module. Communication of information needs more energy than any other process. The power stored in batteries or

ISSN: 2349-7300
ISO 9001:2008 Certified
International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences (IJIRMPS)
Volume 2, Issue 5, October 2014

capacitors is main source of energy in sensor micro module. Solar sources, heat differences, or pulsation etc can be used to renew energy required for sensor.

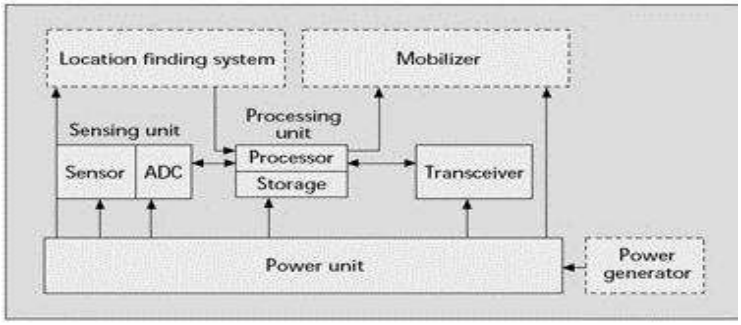

Fig I: Structural diagram of WSN [1]

III. LITERATURE REVIEW

For the design of WSNs Routing is considered to be a important variable. The process of determining a path between source and destination for data transmission is known as ROUTING. The routing protocols in WSN must optimize energy usage, aggregate information, data-centric and application specific. A good routing protocol for WSN are simplicity, energy awareness, adaptability and scalability due to limited energy supply, limited computation power, limited memory and limited bandwidth of WSN . We begin our study with a review of basic terminology and protocols that are energy efficient as well as some proposed methods of improvement and performance.

Joanna Kulik et.al [15]SPIN (sensor protocol for information via negotiation) is a group of protocol for dissemination of data in the wsn.Meta-data negotiations and resource-adaptation are used in SPIN so that a number of deficiency caused in the dissemination process are taken care of micro modules while negotiating with each other for exchange of data's they possess use meta-data names. This ensures that only those data are transmitted during negotiation by micro modules which are necessary; thus wastage of energy on useless transmission is prevented. This is achieved by making the micro modules capable of cutting back on their activities while resources are low to increase their longerity using number of tools.

Four specific SPIN namely SPIN-PP, SPIN-EC, SPIN-BC and SPIN-RL have been discussed elaboratively.Having analyzed SPIN both qualitatively and quantitatively we can conclude as follows;

- The problem of implosion and overlap are overcome by using meta-data successfully.
- SPIN protocols are simple and efficient by maintaing local information about their nearest neighbors. When sensors are mobile these protocols are best suited because their decisions are local neighborhood information.
- Comparatively results and classic flooding by using only 25% energy. Thus coming closer to an ideal dissemination protocol in terms of both time and energy under few conditions.

SPIN-BC and SPIN-RL are capable of acquiring data faster than flooding in case of one to many communications thus saving a greater amount of energy. Also, SPIN-RL dissipates twice the amount of data per unit energy as flooding by converging network packet losses.

Stephanie Lindsey et.al [16]PEGASIS is an improved version of LEACH; rather PEGASIS out performs LEACH by eliminating the overhead of dynamic cluster information shortening to mainimal the distances of non leader micro modules, restrict the number of transmission while receiving from all micro modules but uses one transmission to BS per round. Energy depletion in the network is balanced by rotating the micro modules to transmit the fused data to the BS.Thus robustness of the sensor web is preserved since there could be random death of micro modules occur. The lifetime and quality of network could be enhanced through distributing the

ISSN: 2349-7300
ISO 9001:2008 Certified
International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences (IJIRMPS)
Volume 2, Issue 5, October 2014

energy load among the micro modules.PEGASIS is better version of network than LEACH of direct transmissions protocols.

Arati Manjeshwar et.al [17] Here a new protocol knows as TEEN (Threshold sensitive energy efficient network protocol) is discussed for reactive network. Its performance has been evaluated for a simple temperature sensing application which is necessity in wide fields of industries and environment. This protocol has outperformed the existing conventional protocol. TEEN is efficient in terms of energy consumption and response time. Also, allows the user to control the energy consumption and accuracy to suit the application.

Wendi Rabiner Heinzelman et.al [18] have presented Low Energy Adaptive Clustering Hierarchy protocol which was the energy efficient protocol compare to Minimum Transmission Energy protocol and static clustering method.

Geetu et.al [8]WSNs consisting of small, inexpensive devices or micro modules, have turned into a technology but due to following acute constraints i.e. limited bandwidth, limited processing power, short battery life small storage capability and prone to external threats; that is why wsns is to be improvised to make it energy efficient. Routing protocols makes the transmission in an efficient manner and ensures reliable delivery over multiple-hope relay in wsn. Based on routing algorithm analysis the desirable features of a good energy efficient routing protocol for sensor network are: It should be capable of supporting multiple path to a destination with low overhead and assist in network load balancing.

Mohammed Omari et.al [10] A useful efficient network protocols in wsn should possess small power consumption, scalability and low latency characteristics. Due to advances interest in sensing communication and computation wsn have become very popular in recent years. Here we attempted to compare TEEN and SPIN protocol out of several protocols. They were evaluated for the performance of proactive and reactive wsns. Simulators using the friendly-user java platform were built to carry out comparison in terms of energy consumption and average throughput. SPIN protocol saves large energy in advertising prior to sending data but less performing in terms of throughput where as TEEN simulated differently. Here experimentally SPIN formed to be better over TEEN both in energy consumption and throughput.

TABLE 1 – Comparison Of Different Routing Techniques in WSN

Routing Protocols Technique in wsn	**SPIN**	**LEACH**	**TEEN**	**PEGASIS**
ClassificationofwsnRoutingProtocol	Flat	Hierarchical	Hierarchical	Hierarchical
Energy Efficiency	Sufficient	High	High	Highest
Data Aggregation	Yes	Yes	Yes	No
Scalability	Sufficient	Good	Good	Good
Query Based	Low	High	High	Low
Data Delivery Model	Event driven	Cluster head	Active threshold	Chain based

Table 1 shows the comparison between SPIN, LEACH, TEEN and PEGASIS according to their design characteristics.PEGASIS, LEACH and TEEN are the examples of hierarchical routing protocols they are scalable to the network lifetime. SPIN, LEACH and TEEN have enhanced data aggregation capability. According to different SPIN is better option than LEACH, TEEN and PEGASIS in term of energy consumption protocol.

IV. THE PROBLEMS OF SPIN PROTOCOL

By reviewing different studies literatures on SPIN protocols it is seen that some areas in SPIN protocol need to be improved. As per Different studies various modifications made on SPIN protocol but on improvement as some disadvantages in that need to be solve. The following drawbacks seen as survey made on SPIN protocol.

1. Questional energy efficiency of traditional SPIN.

2. Selective data transmission not possible. In traditional SPIN protocol if data is not forwarded by neighbor micro modules then data will not be received by user.

3.Thera are problem of blind forward and data inaccessible .Despite solving queries related to overlap and implosion in flooding protocol as well avoidance of blind use of resources through SPIN techniques, the problem of blind forward and data in-accessible and other issues do exist.

ISSN: 2349-7300
ISO 9001:2008 Certified
International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences (IJIRMPS)
Volume 2, Issue 5, October 2014

V. PROPOSED METHODS FOR IMPROVEMENT IN TRADITIONAL SPIN

One improvement made is M-SPIN (Modified- SPIN PROTOCOL) to overcome problems in traditional SPIN. Quick and reliable response is required in alarm monitoring applications of wsn.As in case of forest fire warning system, rapid response needed before disaster takes place. It is desirable here, the data must be quickly disseminated to sink micro module at once. M-SPIN routing protocol is better approach for such type of applications than SPIN [11].M-SPIN protocol transmit information directly to sink micro module ether transmitting throughout the network reducing the total number of packet transmission. This result into saving of significant amount of energy. Another interesting fact about energy consumption it is not depending only on sensing of data but on its processing and transmitting or receiving from neighbouring micro modules. If number of transmission and receiving of messages are controlled a fair amount of energy could be saved.

The entire network is divided into two regions, A and B According to the event that occurs in the WSN. Sensor micro modules are on the other side in the network in comparison with the sink micro module in region A but sensor micro modules are on the same side and nearer to the sink micro module in region B. Sensor micro modules of region A can receive data from the event micro module, in receiving or transmitting the data they waste energy. Data will have to travel more hops to reach to sink micro module if they are sent via the micro modules in region A. Thus, it is always desirable during events that the data is sent through the micro modules in region B. This save the energy spent for transmission of a piece of data from an event micro module to the sink micro module. But such selective transmission is not supported in the existing SPIN protocols. Figure 2 shows the data transmission in M-SPIN [11].

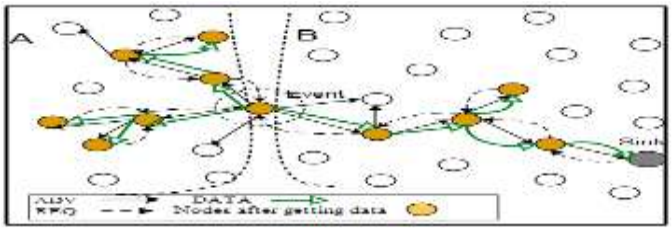

Fig 2. Transmission of M-SPIN data [11].

Mechanism of Working in M-SPIN

A new phase called distance discovery which finds distance of each sensor micro module of WSN from sink micro module in term of hops. The higher value of hop distance micro module means they are far away from sink micro module. On the basis of this hop distance, negotiation is done for sending of an actual data during other phases of M SPIN.Therefore, hop value controls dissemination of data finally data reaching to sink micro module. Working M SPIN mechanism work in three phases:

1. Distance discovery

2. Negotiation

3. Data Transmission

1. Distance discovery

Hope distance is measured from sink micro modules initially sink micro module broadcasts 'Start-up packet' with 'type', 'micro moduleId' and 'hop'. 'Type' means messages, micro moduleId reversals id of micro module sending messages and 'hop' indicates its distance from sink micro module. At first hop is set to 1, the sensor micro modules store this 'hop value' in its memory. Then sensor micro module increases hop value by 1.It re-broadcast the 'start-up' packet is neighbour micro modules with modified hop value. Sensor micro module may also receive' multiple 'star-up' packets from different intermediate micro modules. Figure shows the distance discovery phase of M-SPIN [11].

{ h(a b) i n} i min ∀ , , = 1,

Where h(a b) i , represents 'hop distances' between micro module 'a' i and 'b' and n is number of neighbour micro modules receiving start-up packets. This process remains till all micro modules in network obtain Start-up packets at least once during Distance discovery phase. Next phase will be started for negotiation after the completion of this phase.

ISSN: 2349-7300
ISO 9001:2008 Certified
International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences (IJIRMPS)
Volume 2, Issue 5, October 2014

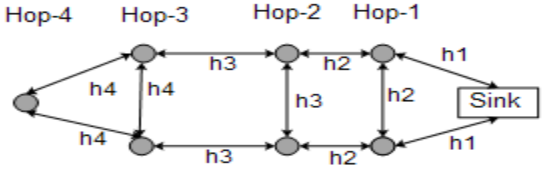

Fig 3.Distance Discovery Phase [11].

2. Negotiation

The Negotiation phase is same to the SPIN-1protocol. ADV message is send by source micro module. After receiving an ADV message, each neighbour micro module clarifies whether it has already received or requested the advertised data. Receiver micro module also verifies whether it is nearer to the sink micro module or not in comparison with the micro module that has sent the ADV message. This differentiates negotiation phase of SPIN_BC and M-SPIN. The receiving micro modules send REQ message to the sending micro module for current data when the hop distance of the receiving micro module (own hop) is less than the hop distance received by receiver micro module as part of the ADV message (rcev_hop),i.e. *own_hop* < *rcev_hop*. By using DATA message the sending micro module then sends the actual data to the requesting micro module

3. Data Transmission

Data transmission phase is similar as SPIN-1 protocol. Data is immediately sent to the requesting micro module after request is received by the source micro module. If the requesting micro modules are intermediate micro modules then the Negotiation phase repeats. The intermediate sensor micro modules broadcast ADV for the data with modified hop distance value. The sending micro modules alter the hop distance field with its own hop distance value and add it in packet format of the ADV message. Till data will not reach the sink micro module the process will continue. Figure 4 shows Negotiation and Data transmission phase [11].

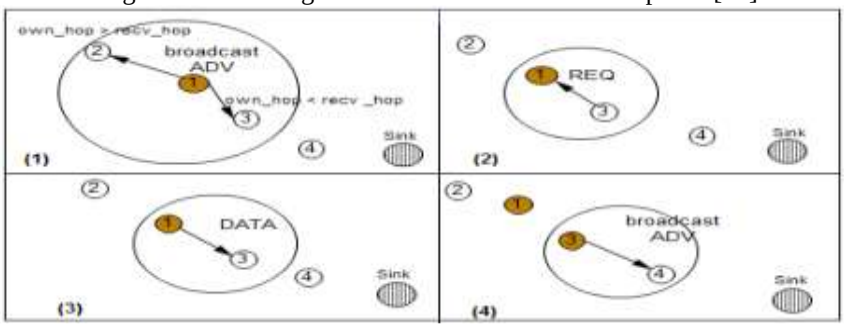

Fig 4.The M-SPIN protocol Shown by [11].

(1) Micro module 1 starts advertising its data to all of its neighbours. (2) Micro module 3 responds by sending a request to micro module 1. (3) After receiving the request, micro module 1 sends the data. (4) Micro module 3 again sends advertisement out to its neighbours for the data that it received from micro module 1.

VI. EXPECTED OUTCOMES

We are proposing SPIN-LA Location Aware (LA) WSN routing protocol which is more energy efficient than the existing protocols. The location aware cluster based routing uses three phases in wireless sensor networks. In the first phase, the location information of each sensor micro module is computed by using the localization algorithm such as Trilateration, Triangulation etc; in the second phase, the sensor micro modules are clustered to minimize the residual energy and maximize the network performance then the Cluster head is elected based on the minimum distance between the cluster micro module's and the centroid; in the third phase, Routing takes place between the cluster head and the cluster members and also between the cluster head and the base station. Thus the data transition power is dedicated regarding to the micro module distance from the hub thus increase the efficiency of M-SPIN Routing method.

ISSN: 2349-7300
ISO 9001:2008 Certified
International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences (IJIRMPS)
Volume 2, Issue 5, October 2014

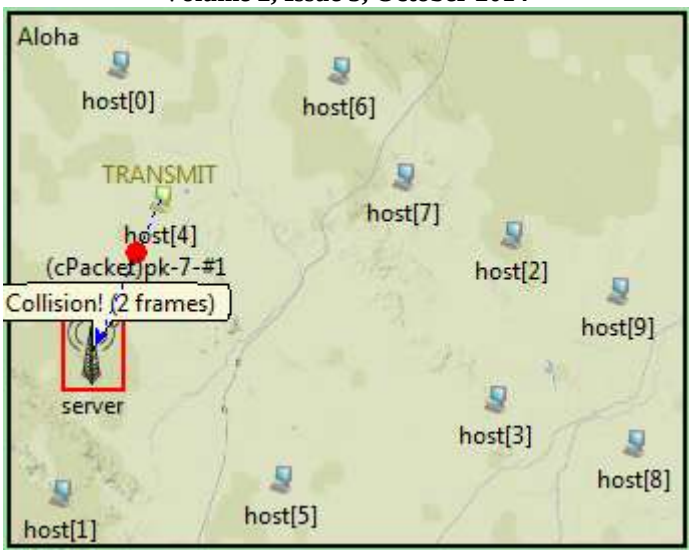

Fig 5 Micro sensor module placement

LOCATION OF SENSOR MICRO MODULE

The location information of each sensor micro module should be known to form a cluster in the wireless sensor network. The micro modules which are deployed in the sensor network, knows their location information. The coordinates (xi, yi) of each sensor micro module are used to estimate the distance between two sensor micro modules. Based on minimum distance and highest residual energy, When a micro module has information about distances or angles and positions, it can compute its own position using any one of the localization method. Several methods can be used to compute the position of a micro module such as trilateration, multitrilateration, triangulation etc. Trilateration is a geometric principle which is used to find a location, if their distances from other micro modules are known. It computes a micro module's position via the intersection of three circles. To calculate the unknown micro module's location, trilateration uses the known locations of two or more reference points, and the measured distance between the unknown micro module and each reference point. To accurately and uniquely determine the relative location of a micro module using trilateration, generally at least three reference points are needed.

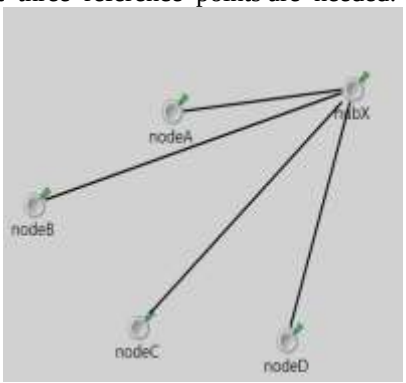

Fig 6 SPIN Triangulation

VII. CONCLUSION AND FUTURE WORK

It is attempted through this paper to propose a modified spin (M-SPIN) protocol applying hop-count values of sensor micro modules for wsn. Prior to sending the actual data the negotiation is carried out. The data are disseminated to sink or neighbors to sink micro modules, in response to ADV packet from source micro module against REQ packets from close by micro modules. The M-SPIN saves energy by discarding transmission of packets in the opposite direction of the sink micro module. Since few of the sensor micro modules are to be used repeatedly several times causing dissipation of energy which will result into a major problem due to their decaying.

ISSN: 2349-7300
ISO 9001:2008 Certified
International Journal of Innovative Research in Engineering & Multidisciplinary Physical Sciences (IJIRMPS)
Volume 2, Issue 5, October 2014

Cluster algorithm shall be alternate to avoid decay of such micro modules. The trilateration works on geometric principle of finding distances, is the alternative of the M-SPIN protocol problem.

REFERENCES

[1] www.observatorynano.eu/project/catalogue/2SE.CO/2326/.

[2] Kajal V. Shukla Smt. Chandaben Mohanbhai, ''Research on Energy Efficient Routing Protocol LEACH for Wireless Sensor Networks'', Patel Institute of Computer Applications CHARUSAT CHANGA International Journal of Engineering Research & Technology (IJERT) Vol. 2 Issue 3, March – 2013.

[3] Ouadoudi Zytoune, Driss Aboutajdine, ''An Optimized Energy Aware Chaining Technique for Data Gathering in Wireless Sensor Networks'', International Journal of Digital Information and Wireless Communications (IJDIWC) 3(2): 41-49 The Society of Digital Information and Wireless Communications, 2013 (ISSN: 2225-658X).

[4] P.Krishnaveni, Dr.J.Sutha, ''Analysis of routing protocols for wireless sensor networks'', International Journal of Emerging Technology and Advanced Engineering Website: www.ijetae.com (ISSN 2250-2459, Volume 2, Issue 11, and November 2012).

[5] Rajashree, V., Biradar, V.C., Sawant S.R., and Mudholkar, R.R., "Classification and comparison of Routing Protocols in Wireless Sensor Networks", Ubiquitous Computing Security Systems Journal, Vol. 4, pp. 704-711,2012.

[6] Prabhat Kumar, M.P.Singh, U.S.Triar, ''A Review of Routing Protocols in Wireless Sensor Network'', International Journal of Engineering Research & Technology (IJERT) Vol. 1 Issue 4, June – 2012.

[7] M.Kavitha, K. Karthikeyan, ''Comparison of Data Centric Protocols for WSN and Energy Enhanced M-SPIN (EEM-SPIN)'', International Journal of Engineering Research & Technology (IJERT) Vol. 1 Issue 9, November- 2012.

[8] Geetu,Sonia Juneja, ''Performance Analysis of SPIN and LEACH Routing Protocol in WSN'',Deptt. Of Comp. Sc. & Engg HCE, Sonepat, India International Journal of Computational Engineering Research 2012.

[9] M.Shankar, Dr.M.Sridar, Dr.M.Rajani, " Performance Evaluation of LEACH Protocol in Wireless Network'',.International Journal of Scientific & Engineering Research, Volume 3, Issue 1, January-2012.iinternational Journal of Engineering Research & Technology (IJERT) Vol. 1 Issue 4, June – 2012.

[10] Mohammed Omari, Noura Tiouririne, and Djamila Dahmani ''Simulation of the TEEN and the SPIN Protocols in a Wireless Sensor Network'', Environment Cyber Journals: Multidisciplinary Journals in Science and Technology, Journal of Selected Areas in Telecommunications (JSAT), October Edition, 2012.

[11] Zeenat, R., Sarbani, R., and Nandini, M., "A Modified SPIN for Wireless Sensor Networks", IEEE transactions on wireless sensor networks Vol. 11, pp 978-982, 2011.

[12] Padmanabhan, K., and Kamalakkannan, P., "A Study on Energy Efficient Routing Protocols in Wireless Sensor Networks", European Journal of Scientific Research, Vol. 60, No. 4, pp. 499-511 ,2011.

[13] Al-Karaki, J.N., Kamal, A.E., "Routing Techniques in Wireless Sensor Networks: A Survey", IEEE transactions on Wireless Communications, Vol.11, No. 6, pp. 6-28,2004.

[14] Akyildiz,I.F.,Su, W., Sankarasubramaniam, Y., and Cayirci, E., "Wireless sensor networks: a survey", Elsevier Journal of Computer Networks, Vol. 38, No. 4, pp. 393-422 ,2002.

[15] Jonna, K., Rabiner, W., and Hari Balakrishanan, "Negotiation -based protocols for Disseminating information in Wireless Sensor Networks", ACM Wireless Networks,, Vol. 8, pp. 169-185,2002.

[16] S. Lindsey, C. Raghavendra, ''PEGASIS: Power-Efficient Gathering in Sensor Information Systems", IEEE Aerospace Conference Proceedings, Vol. 3, 9-16 pp. 1125-1130, 2002.

[17] A. Manjeshwar and D. P. Agarwal, "TEEN: a Routing Protocol for Enhanced Efficiency in Wireless Sensor Networks," 1st Int"l. Wksp. on Parallel and Distrib. Comp. Issues in Wireless Networks and Mobile Comp., April 2001.

[18] W. Heinzelman, A. Chandrakasan and H. Balakrishnan, "Energy-efficient Communication Protocol for Wireless Microsensor Networks," Proceedings of the 33rd Hawaii International Conference on System Sciences (HICSS '00), January2000.

[19] W. Heinzelman, J. Kulik, and H. Balakrishnan, "Adaptive Protocols for Information Dissemination in Wireless Sensor Networks," Proc. 5th ACM/IEEE Mobicom Conference (MobiCom '99), Seattle, WA, August, 1999. pp. 174-85.