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An Implementation of Energy Efficient Technique in Wireless Sensor Network

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Abstract: *Wireless sensor nodes can be deployed on a battlefield and organize themselves in a large-scale ad-hoc network. Traditional routing protocols do not take into account that a node contains only a limited energy supply. Optimal routing tries to maximize the duration over which the sensing task can be performed, but requires future knowledge. Wireless sensor network is an ad hoc network. Each sensor is defined with limited energy. Wireless sensor node deployed into the network to monitor the physical or environmental condition such as temperature, sound, vibration at different location. Each node collected the information than transmit to the base station. The data is transfer over the network each sensor consume some energy in receiving data, sending data. The lifetime of the network depend how much energy spent in each transmission. The protocol play important roll, which can minimize the delay while offering high energy efficiency and long span of network lifetime. Here we analysed the AODV protocol with its extended version named as MAODV protocol and it is observed that MAODV performs better than AODV protocol.*

Keywords: *WSN, Energy Efficiency, Routing, AODV, MAODV.*

1. INTRODUCTION

Wireless sensor networks gather data from places where it is difficult for humans to reach and once they are deployed, they work on their own and serve the data for which they are deployed [1]. A wireless sensor network consists of sensor nodes deployed over a geographical area for monitoring physical phenomena like temperature, humidity, vibrations, seismic events, and so on. Typically, a sensor node is a tiny device that includes three basic components: a sensing subsystem for data acquisition from the physical surrounding environment, a processing subsystem for local data processing and storage, and a wireless communication subsystem for data transmission [2].

Minimizing energy dissipation and maximizing network lifetime are important issues in the design of protocols and applications for sensor networks. Energy-efficient sensor state planning consists in finding an optimal assignment of states to sensors in order to maximize network lifetime. For example, in area surveillance applications, only an optimal subset of sensors that fully covers the monitored area can be switched on while the other sensors are turned off. Typically, any sensor can be turned on, turned off, or promoted as a cluster head, and a different power consumption level is associated with each of these states [3].

Coverage is usually interpreted as how well a sensor network will monitor a field of interest. Typically we can monitor an entire area, watch a set of targets, or look for a breach among a barrier. Coverage of an entire area otherwise known as full or blanket coverage it means that every single point within the field of interest is within the sensing range of at least one sensor node [4]. A sensor network deployment can usually be categorized as either a dense deployment or a sparse deployment. A dense deployment has a relatively high number of sensor nodes in the given field of interest while a sparse deployment would have fewer nodes. The dense deployment model is used in situations where it is very important for every event to be detected or when it is important to have multiple sensors cover an area. Sparse deployments may be used when the cost of the sensors make a dense deployment prohibitive or when we want to achieve maximum coverage using the bare minimum number of sensors [5].

The design of micropower wireless sensor systems hasgained increasing importance for a variety of civil and military applications. With recent advances in MEMS technologyand its associated interfaces, signal processing, and RF circuitry, the focus has shifted away from limited macrosensorscommunicating with base stations to creating wireless networks of communicating microsensors that aggregate complex data to provide rich, multi-dimensional pictures of theenvironment. While individual microsensor nodes are not asaccurate as their macrosensor counterparts, the networking ofa large number of nodes enables high quality sensing networks with the additional advantages of easy deployment and faulttolerance [6]. These characteristics that make microsensorsideal for deployment in otherwise inaccessible environmentswhere maintenance would be inconvenient or impossible.

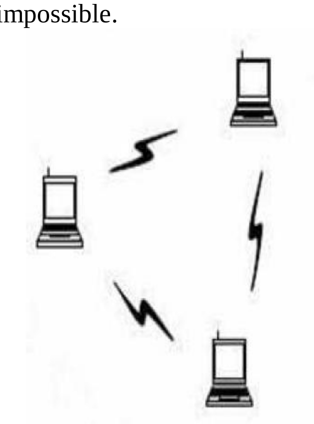


Figure 1: An Example of Wireless Sensor Network

The potential for collaborative, robust networks of micro sensors has attracted a great deal of research attention. The WINS and Pico Radio and projects, for instance, aim to integrate sensing, processing and radio communication onto a micro sensor node. Current prototypes are custom circuit boards with mostly commercial, off-the-shelf components. The Smart Dust project seeks a minimum-size solution to the distributed sensing problem, choosing optical communication on coin-sized "motes." The prospect of thousands of communicating nodes has sparked research into network protocols for information flow among micro sensors, such as directed diffusion. The unique operating environment and performance requirements of distributed micro sensor networks require fundamentally new approaches to system design [7]. As an example, consider the expected performance versus longevity of the micro sensor node, compared with current battery-powered portable devices.

2. LITERATURE REVIEW

Gerard chalhoub and Michel misson [8], proposed a time segmentation approach that saves energy, enables quality of service in terms of guaranteed access to the medium and improves the overall performance of the Network. This time segmentation is achieved by synchronizing nodes activity using tree-based topology. A synchronization period that guarantee collision free beacon propagation along the cluster-tree. Then they propose a data collection period in order to improve the energy efficiency of the network and the network performance. Finally, by adding relay time intervals between coordinators, able to improve further more the network performance and guarantee an end-to-end delay. Their results show that the overall Estimated energy consumption have reduced with respect to a cluster-tree configuration, the percentage of received frames is increased by 20 % to 40 %, and the average number of collisions is divided by 2 in most cases.

Liu Yueyang, Ji Hong, Yue Guangxin [9], proposed a new chaining algorithm EB-PEGASIS, which uses distance threshold to avoid this phenomenon in PEGASIS. Using this algorithm, the sensor networks can achieve energy balance and prolong network lifetime. This enhanced algorithm EB-PEGASIS, which can avoid "long chain" in chaining process through average distance of network. EB-PEGASIS can guarantee approximately the same in consumed energy of sensor nodes and avoid the dying of some nodes early than other nodes to protract the period of sensor network.

Kunjan Patel, et al. [10], presented a reliable and lightweight routing protocol for wireless sensor networks in their paper. They claimed more than 90% savings in number of transmissions compared to the message flooding scheme when the same route was used to transmit data messages. This saving increased exponentially as the number of transmissions increased over a same route. The protocol occupied only 16% of total available RAM and 12% of total program memory in MICA platform which make it very lightweight to implement in wireless sensor networks.

Mohamed Hafeeda and Hossein Ahmadi [11], proposed a new probabilistic coverage protocol (denoted by PCP) that considered probabilistic sensing models. PCP was fairly general and used with different sensing models. In particular, PCP required the computation of an indivisible parameter from the supported sensing model, while all other things persists same. They showed how this parameter could be derived in general, and the calculations for two example sensing models: (i) the probabilistic exponential sensing model, and (ii) the commonly-used deterministic disk sensing model. They compared their protocol with two existing protocols and claimed for the better performance as they proposed.

Samia A. Ali and Shreen k. Refaay [12], proposed an efficient routing protocol called CCBRP (Chain-Chain based routing protocol). It achieves both minimum energy consumption and minimum delay. The CCBRP protocol mainly divides a WSN into a number of chains using Greedy algorithm and runs in two phases. In the first phase, sensor nodes in each chain transmit data to their chain leader nodes in parallel. In the second phase, all chain leader nodes form a chain and randomly choose a leader node then all nodes send their data to this chosen leader node. This chosen leader node fuses the data and forwards it to Base Station (BS). Experimental results demonstrate that the energy consumption of the proposed CCBRP is almost as same as for PEGASIS and 60% less than LEACH and 10% less than CCM for WSN with hundred nodes distributed in 100m x 100m area. The delay of the proposed CCBRP is the same as of LEACH and CCM but 75% less than of PEGASIS.

Nisha Sarwade et. al. [13] presented in this paper some of the major power-efficient hierarchical routing protocols for wireless sensor network used. In a hierarchical architecture, higher energy nodes can be used to process and send the information while low energy nodes can be used to execute the sensing in the adjacency of the destination. This means that creation of clusters and assigning special tasks to cluster heads can greatly contribute to overall system scalability, period, and energy decisive. Hierarchical routing is an efficient way to lower energy consumption within a cluster and by performing data aggregation and fusion in order to decrease the number of transmitted messages to the BS. Hierarchical routing is mainly two-layer routing where one layer is used to select cluster heads and the other layer is utilize for routing.

Tarun Gulati et. al. [14] proposed this paper on node reliability in Wireless sensor network. Each sensor is defined with limited energy. Wireless sensor node deployed into the network to monitor the physical or environmental condition such as temperature, sound, vibration at different location. The protocol play important roll, which can minimize the delay while offering high energy efficiency and long span of network lifetime. One of such protocol is PEGASIS, it is based on the chain structure, every chain have only one cluster head, it is in charge with every note's receiving and sending messages who belong to this chain, the cluster head consumes large energy and the times of every round increasing. In PEGASIS, it take the advantage of sending data to it the closet neighbor, it save the battery for WSN and increase the lifetime of the network. The proposed work in this paper is about to select the next neighboring node reliably.

3. AODV

Ad Hoc on Demand Distance Vector Routing (AODV) is an example of pure reactive routing protocol. AODV belongs to multi-hop type of reactive routing. AODV routing protocol works purely on demand basis when it is required by network, which is fulfilled by nodes within the network. Route discovery and route maintenance is also carried out on demand basis even if only two nodes need to communicate with each other. AODV cuts down the need of nodes in order to always remain active and to continuously update routing information at each node. In other words, AODV maintains and discovers routes only when there is a need of communication among different nodes. AODV uses an efficient method of routing that reduces network load by broadcasting route discovery mechanism and by dynamically updating routing information at each intermediate node. Change in topology and loop free routing is maintained by using most recent routing information lying among the intermediate node by utilizing Destination Sequence Numbers of DSDV.

4. MAODV

Multicast protocol is a key technique to the group team application, which benefits in the significant reduction of network loads when packets need to be transmitted to a group of nodes. Multicast protocol must guarantee the performance requirements: adaptable to the dynamic change of network topology, timeliness, minimizing routing overhead and efficiency etc. Multicast is a communication approach for groups on information source using the single source address to send data to hosts with same group address. MAODV topology is based on multicast tree adopting broadcast routing discovery mechanism to search multicast routing, which sends data packets to each group nodes from data source.

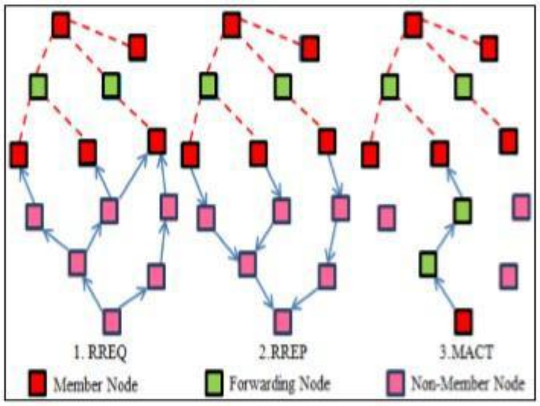


Figure 2: MAODV Protocol

Route Discovery

MAODV use route request (RREQ) and route reply (RREP) which already exist in AODV. If a node wants to join in or send messages to a multicast group while there is no path to the multicast group, it will broadcast a RREQ, any multicast group member will respond to the request message if necessary. If RREQ is not a Join Request, any node with updated (serial number is greater than RREQs) routing path can respond directly. If non-multicast node receives RREQ request, or the node is not available to the target group, it will forward RREQ directly.

Route Maintenance

a) Multicast Tree Maintenance: Group leader main- tains the multicast groups' serial number by broadcasting Group Hello periodically. Group Hello is extended from the Hello message in AODV, which is consisted of multicast address, multicast serial number, hop count and TTL (Time to live).

b) Node Leave: If the node is not a tree leaf, it still can act as a router only by setting multicast address 0, else it will send Add and Prune (P marked MACT) to prune itself. When its upstream node receives P-marked MACT, it will delete this node from its multicast routing table. If the node is a multicast member or not a tree leaf, the prune process ends, else send the P-Marked MACT to its upstream node continuously.

c) Disconnection Repair: When the link is disconnected due to node mobility or other reasons, it will broadcast RREQ to re-join in the multicast group, only the member with latest serial number and its hop less than multicast group hop can respond. If the upstream node which has lost its node is not a multicast group member, and becomes the tree leaf, then it will set the timer to rebuild and if in certain period, it is still not be activated, the Add and Prune will be sent to prune the node itself. If the network is divided due to the repair failure, the divided network needs new group leader. If the nodes initiating repair is a multicast group member, then it will become the group leader, or the new group leader will be selected by sending G-Marked MACT.

d) Tree Merge: When the node receives Hello message, if it is a multicast group member and contains group members of the lower address group leader, it will initiate tree-rebuild process.

Link Repair Mechanism of MAODV

In MAODV, when a link breakage is detected, the downstream node is responsible for initiating the repair procedure. In order to repair the tree, downstream node broadcasts RREQ-J message with multicast group leader extension included. The multicast group hop count field in multicast group leader extension is set equal to node's current distance to multicast group leader, only nodes no further to the group leader can respond. A node receiving the RREQ-J respond by unicasting a RREP-J only if it satisfy the following constraints: It is a member of the multicast tree, its record of the multicast group sequence number is at least as great as that contained in RREQ-J and its hop count to the multicast group leader is less than or equal to the contained in the multicast group hop count extension field. After waiting for RREP-J wait time, the source node selects the best path from the RREP-J messages received and subsequent route activation is performed by a MACT-J message. Once the repair is finished, it is likely that the node which initiated the repair is now at a different distance to the group leader. In this case, it must inform its downstream nodes about their new distance to the group leader. The node performs this task by broadcasting a MACT-J message with the new hop count to leader contained. When a downstream node receives the MACT-J message and determines that this packet arrived from its upstream node, it increments the hop count value contained in the MACT-J and updates its distance to the group leader. The problem associated with this link repair mechanism is that the shortest path to the group leader is not ensured and it can lead to tree partitioning.

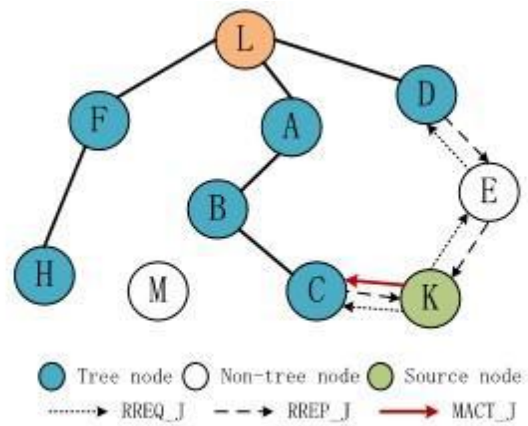


Figure 3: Link Repair Mechanism of MAODV

5. ENERGY-EFFICIENT NETWORKS

Once the power-aware micro sensor nodes are incorporated into the framework of a larger network, additional power-aware methodologies emerge at the network level. Decisions about local computation versus radio communication, the partitioning of computation across nodes, and error correction on the link layer offer a diversity of operational points for the network [8].

6. IMPLEMENTATION AND RESULTS

Packet Delivery Ratio:

Packet delivery ratio is the ratio of packets that are successfully delivered to a destination compared to the number of packets that have been sent by sender. The fig shows the effect to the packet delivery ratio (PDR) measured for the AODV, MAODV protocols when the node Density is increased.

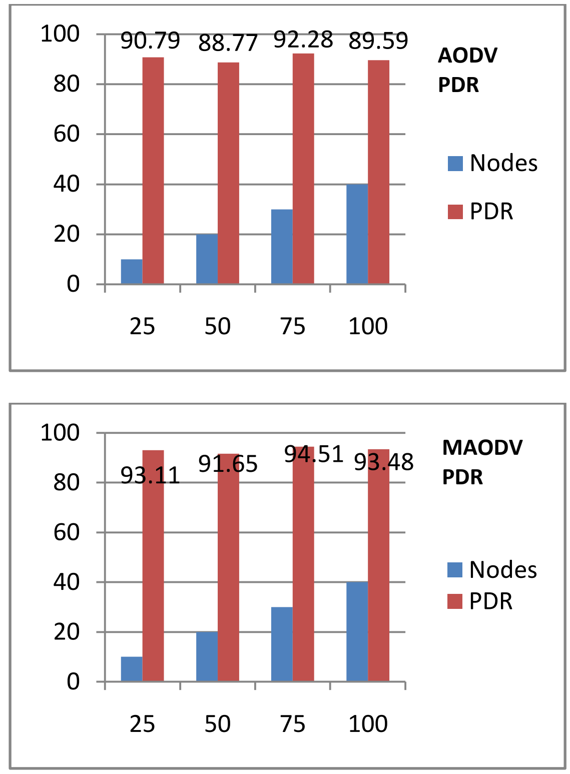
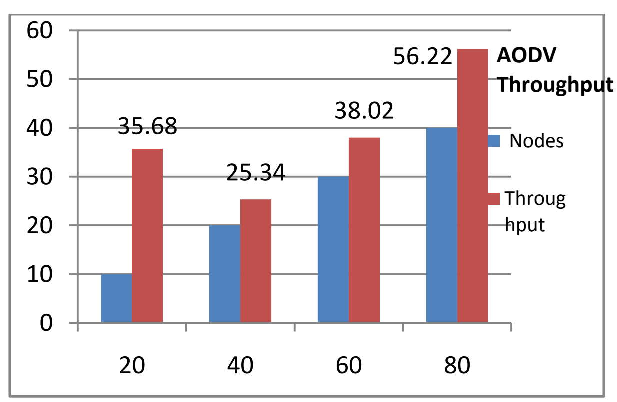


Fig 4: PDR Result

Throughput

Network throughput is the average of successful message delivery over a communication channel. This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second or data packets per time slot.



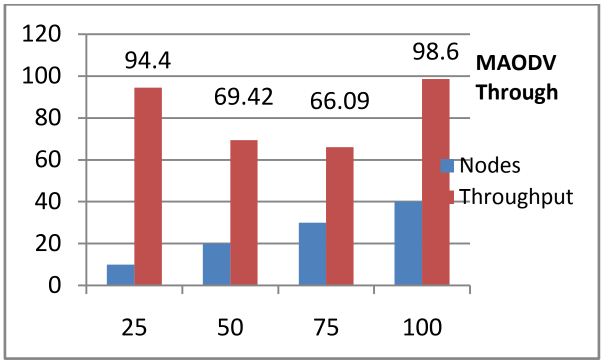


Fig 5: Throughput Result

Energy

This is the average Energy between the sending of the data packet by the source and its receipt at the corresponding receiver. This includes all the delays caused during route acquisition, buffering and processing at intermediate nodes.

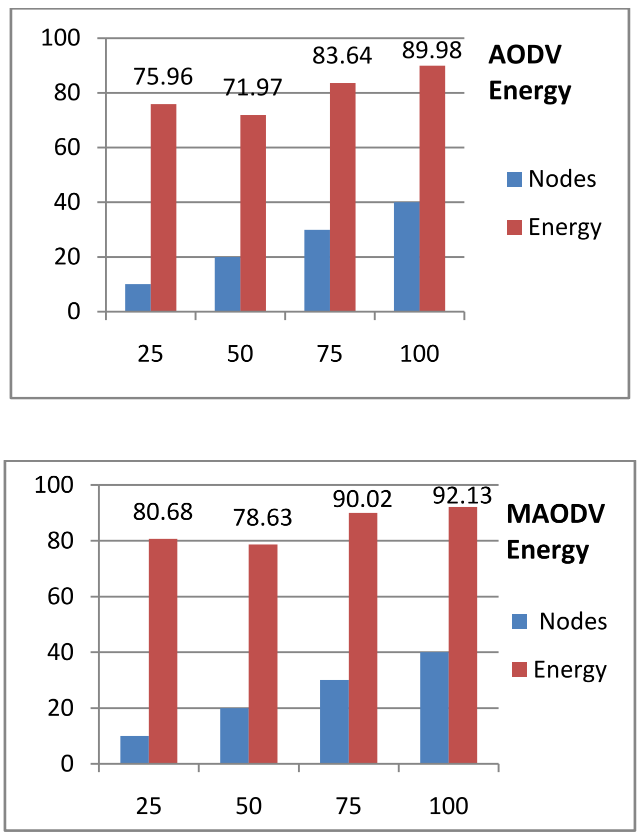


Fig 6: Energy Result

End to End Delay

This is the average delay between the sending of the data packet by the source and its receipt at the corresponding receiver. This includes all the delays caused during route acquisition, buffering and processing at intermediate nodes.

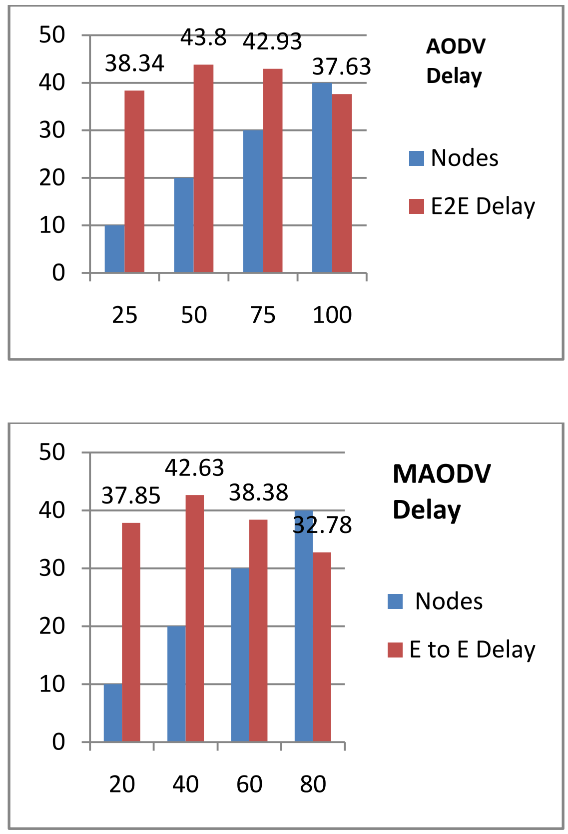


Fig 7: End To End Delay Result

7. CONCLUSION

In this paper, we describe MAODV and AODV which are implemented in NS2 by eliminating the overhead Due to the energy constraints, wireless sensors usually have a limited transmission range, making multi hop data routing towards the PN (processing node) more energy efficient than direct transmission (one hop). A primary design goal for wireless sensor networks is to use the energy efficiently. The proposed system will improve the existing AODV protocol. The simulation results shows that MAODV protocol gives higher energy-efficiency in Network Simulation.

REFERENCES

[1] Rajgopal Kannan, Ram Kalidindi, S. S. Iyengar, "Energy and Rate based MAC Protocol for Wireless Sensor Networks", International Symposium on Communication Theory and Applications, Louisiana State University, Dec 2003.

[2] N. Bulusu, D. Estrin, L. Girod, and J. Heidemann, Scalable coordination for wireless sensor networks: self-configuring localization systems, International Symposium on Communication Theory and Applications (ISCTA2001), Ambleside, UK, July 2001.

[3] Adam Dunkels, Juan Alonso, Thiemo Voigt Making TCP/IP Viable for Wireless Sensor Networks Swedish Institute of Computer Science, June2003.

[4] Michele Zorzi and Ramesh R. Rao, "Energy and latency performance of geographic random forwarding for ad hoc and sensor networks" UdRCNIT, University of Ferrara Saragat, Ferrara, Italy, June2002.

[5] P. Jeyabharathi, A. Sivasankari, M. Maharasi, "An Efficient Security Mechanism for Data Reporting In Wireless Sensor Networks" www.ijera.com Vol. 3, Issue 5, , pp. 333-338, Sep-Oct 2013.

[6] Broch, J., Maltz, D., Johnson, D., Hu, Y. Jetcheva, J., "A performance comparison of multi-hop wireless Adhoc network routing protocols," Mobicom'98, Dallas, Texas, pp.85-97, Oct. 1998.

[7] Pearlman, M., Haas, Z., "Improving the Performance of Query-Based Routing Protocols through 'Diversity- Injection'," WCNC'99, New Orleans, LA, pp. 1546- 1550, Sept. 1999.

[8] Gerard Chalhoub and Michel Misson, "Cluster-tree Based Energy Efficient Protocol for Wireless Sensor Networks", International Conference on Networking, Sensing and Control (ICNSC) IEEE, pp. 664-669, April 2010.

[9] Liu Yueyang, Ji Hong and Yue Guangxin, "An Energy-Efficient PEGASIS Based Enhanced Algorithm in Wireless Sensor Networks", China Communications, pp. 91-97, August 2006.

[10] Kunjan Patel,, C.J. Bleakley and Wim Vanderbauwhede, "A Reliable Lightweight Multi-hop Wireless Sensor Network Routing Protocol", International Conference on Computational Science and Engineering, October 2009.

[11] Mohamed Hafeeda and Hossein Ahmadi, "A Probabilistic Coverage Protocol for Wireless Sensor Networks", International Conference on Network Protocols, November 2007.

[12] Samia A. Ali and Shreen K. Refaay, "Chain-Chain Based Routing Protocol", International Journal of Computer Science Issues (IJCSI), Volume 8, Issue 3, No. 2, pp. 105-112, May 2011.

[13] Sanjay Waware, Nisha Sarwade and Pallavi Gangurde, "A Review of Power Efficient Hierarchical Routing Protocols in Wireless Sensor Networks", International Journal of Engineering Research and Applications (IJERA), Volume 2, Issue 2, pp.1096-1102, March-April 2012

[14] Sunita Rani and Tarun Gulati, "An Improved PEGASIS Protocol to Enhance Energy Utilization in Wireless Sensor Network", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 2, Issue 11, pp. 448-253, November 2012