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An Energy Efficient Optimal Path Selection Using AODV Protocol in Wireless Sensor Network

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Abstract:- Wireless sensor network is a vast and emerging field. Due to its ubiquitous nous, the wireless nodes are implemented in almost all the areas. Energy efficiency and reliability in data transfer is the primary concern when it comes to implementing wireless nodes for critical applications. In this paper, Successive Convex Approximation Algorithm (SCA) is used along with AODV to improve the data reliability and manage the energy in the network efficiently. The algorithm finds the shortest path to the node using the algorithm in an existing convex network. During the selection of nodes, the energy levels of all the nodes are monitored to improve the network lifetime as a whole.

Keywords:- *Wireless Sensor Networks, SCA, AODV.*

I. INTRODUCTION

In wireless sensor network, the network lifetime and data transfer reliability can be increased by the selection of appropriate topology. There is the requirement for efficient use of energy due to the nodes brings energy powered. AODV routing protocol transfers the data to all the nodes in its vicinity resulting in data collision and generous use of the power of all the nodes thereby decreasing the network lifetime drastically. The Successive Convex Approximation Algorithm (SCA) is used in conjunction with AODV for capturing this and also for the efficient use of energy and for minimizing data loss. AODV approach in isolation not only increases the consumption of energy for a particular node but also aggravates the risk of data collision for the other nodes in its vicinity. Successive Convex Approximation Algorithm (SCA) is used for avoiding this and for convexing a particular number of nodes to form a group. Each group has a master that controls the flow of data and also keeps track of the energy level of all the nodes in its network. In case a node needs transmission of data to another node of the same network then the data path is selected by the master node according to the Successive Convex Approximation Algorithm (SCA). Similarly, if the data needs to be transmitted to the other node of a different network, the master node of two networks communicate in deciding the shortest path for the communication. The energy levels of the nodes are already available with the master nodes. The nodes with the least amount of energy are left, and the data are transferred using only the node that has larger energy compared to all the other nodes. The algorithm chooses the shortest path with these nodes. This not only ensures efficient use of energy but, even move than that, minimizes data collision. Since the data's are routed by a path selected by the Successive Convex Approximation algorithm (SCA), the data will flow through nodes resulting in eradicating data loss in all the other nodes in its vicinity.

II. RELATED WORK

Beamforming technique is performed for transmission of sharing the data load among all the other nodes to reduce fast battery usage. Convex optimization used herein improves network lifetime and satisfies all the criteria. The energy utilization problem is tackled using both the centralized and distributed algorithms using convex and consensus algorithms [1].

Network plays a significant role in a large scale wireless network distributed in the circuit. A Blood pressure (Bp) based in-network is used for reduction of interference in wireless sensor network. Additionally, a wavelet based Bp network is used for reducing energy consumption [2].

Comprehensive sensing theory based measurements are used for measurement of network lifetime along with other approaches. Models of energy dissipation of different models are built to form a mixed integer programming that records energy consumption. The result shows improvement in the network life time through the use of comprehensive sensing which is highly beneficial for wireless sensor networks [3]. The network connectivity and lifetime are improved through use of unidirectional links. The acknowledgment signal needs transfer through the multihop reverse hop for efficient use of unidirectional links. But the increase in the length of reverse path increases the energy consumption of the nodes and as well as increases the overhead, also which in turn increases the complexity of data in the network [4].

WSNs applications largely depend on power supply units. Batteries are used as power supply units in WSNs. The battery technology was not developed as quickly as WSNs growth. So lack in power supply motivates the researchers in developing energy aware routing framework. A detailed survey that has been under taken for developing energy aware framework shows scanning of neighbor nodes in larger networks using the primary source of power. Discovery protocols are implemented for overcoming this problem. Here we use birthday protocol that combines with NDP using characteristics of randomness. Many ideas have been examined and compared with protocol for generation of higher energy efficient neighbour discovery framework. [5].

Information gathering wireless sensor systems (WSNs) are worked unattended over a long time skylines collecting information in a few applications, for example, those in atmosphere observing an assortment of biological studies. Ordinarily, sensors have restricted vitality (e.g., an on-board battery) and are liable to the components in the landscape. In-system operations which, to a great extent, include intermittently changing system stream choices to drag out the system lifetime are overseen remotely, and the gathered information is recovered by a client through the web. In this paper, we consider an integrated topology control and directing issue in bunch based WSNs. We embrace a leveled system structure with numerous sinks whenever in the information gathered by the sensors is assembled through Cluster Heads (CH). This is done for extending the system life time through productive utilization of the restricted vitality at the sensor. We consider the Mixed Integer Linear Programming (MILP) method as ideal for the decision relating to the sink and for the information stream in the system. Our model viable uses both the position and the vitality level parts of the sensors while selecting the CHs and dodges the most noteworthy vitality sensors, on the other hand, the sensors that are very much situated sensors as for sinks are chosen as CHs over and over in modern periods. For the arrangement of the MILP model, we add to a successful Benders Disintegration (BD) approach that joins an upper bound heuristic calculation, fortified cuts, and a - ideal structure for quickened merging. Computational proof exhibits the proficiency of the BD approach and the heuristic as far as arrangement quality and time. [6]

Nodes that do transmission alone are more advantageous than other nodes due to low cost and energy consumption. But the Medium Access Control (MAC) layer is not issued for transmitting nodes alone and without receiver nodes. So a new MAC layer Robust Asynchronous Resource Estimation (RARE) protocol is used for management of densely populated cluster networks. The proposed model is simulated which showing improved data delivery rate, energy consumption and reliability in the network [7].

Trust based routing method is used for increasing data reliability. A light weight trust-based routing protocol is used for sensing the optimal path for data transfer. Local variables are used to carry out this operation. Hence, the scalability is increased. An AODV base routing protocol is used to validate the proposed approach [8].

The selection of path is done using end to end delay in the multi wireless mesh network. The EED metric control methods, MR-MC are used to compute MRAB. The metric weighted end to end delay is formed by combining MRAB and EED. The channel diversity is represented by channel diversity coefficient. WEED based routing protocol is used to extend the AODV protocol [9].

A generalized trust model is implemented in preference to other routing models. Malicious nodes affect the working of the network entirely. The regression-based trust model is used for singling out malicious nodes. AODV and optimized link state routing protocol are used for making the proposed model. This method helps increasing the throughput in the network with minimal overheads. The proposed model was implemented on an ad-hoc network, and the model was able to identify malicious activity in the network. By doing so, the alternate path can be used to transfer data. [10]

III. METHODOLOGY

Wireless Sensor Network plays a vital role in many applications for collection and transfer of data between nodes and the base station. Network lifetime and performance of the WSNs majorly depend on the limited power source provided to it. The WSNs nodes are powered by a battery source, so power efficient routing protocol is required to increase the performance and lifetime of the WSNs. Here we have used Successive convex approximation along with AODV protocol to provide energy efficiency to the network.

Initially, AODV routing protocol is used to identify the shortest path between the source node and destination node before establishing the communication. While performing this process, the node needs to transfer the REQ message to the nodes placed near to it and the nodes receiving the REQ message will pass the message to their next nodes with the details of the source node and the path it comes from, this procedure is repeated till the message reaches the destination. Then the destination node selects the shortest path from the received REQ message and chooses the path of communication and sends the REPLY message to the source. While performing this action, the message is passed to each and every node in the network and repeated message packets are dropped by the nodes while scanning for the destination node. So, a large number of packets of information get dissipated in the process of finding the path of the target node. AODV protocol follows this procedure every time it establishes the connection between the destination node, so thereby increasing the dropping packet which leads to energy loss in transmitting and receiving unwanted request messages. Successive Convex Approximation is used for overcoming this limitation. This method groups the nodes present in the network. Based on the distance between the last node and the base station a total number of groups are created and each group posses one group head node. This group head nodes posses the information about the nodes in the group and make a link between the next group head find the path to the base station. The AODV protocol is applied to the group heads to find the interlink path between the group heads and the base station.

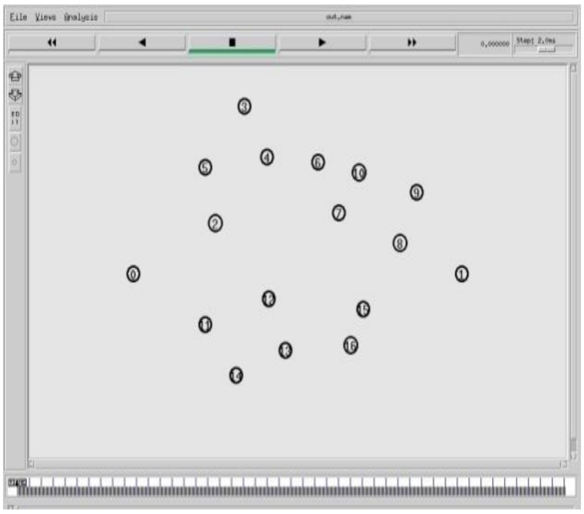

Fig. 1. Initial Node Positions

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Fig. 1 above shows the initial positioning of nodes in the network. Successive Convex Approximation is applied to the network for helping intra grouping.

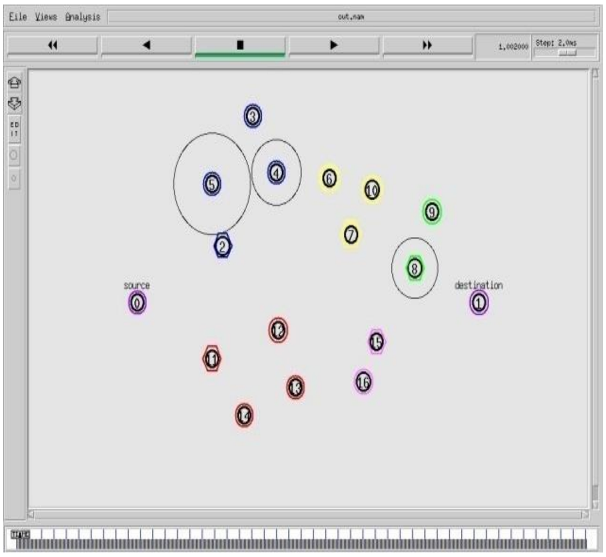

Fig. 2. Successive convex approximation

Fig. 2 above shows the grouped nodes in the network based on the position of source and destination in the network. Group heads are represented with hexagon and member nodes are circled. Each color represents a group. Communication is established between the source and destination nodes using AODV protocol.

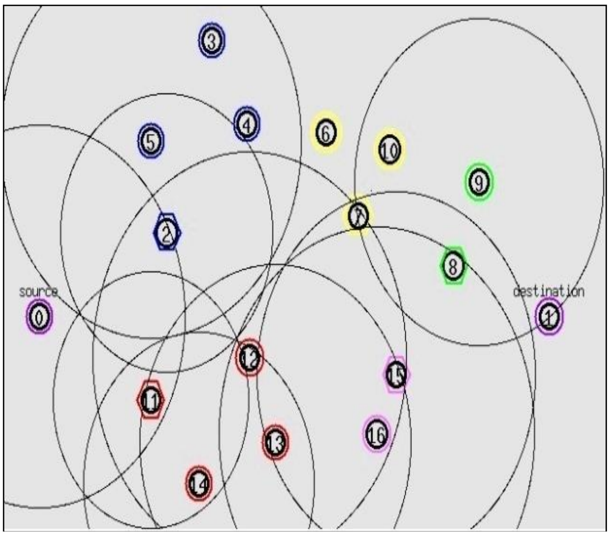

Fig. 3. Initializing path between source and destination.

Fig. 3. above shows REQ message transmission between the nodes for providing the information about the nodes in the group and generates a link between the group heads in the network. Then the data is transmitted between the source and destination through the shortest path of connected group heads using AODV protocol.

- *Algorithm*

Step1: Initialize the nodes in the network.

Step2: Identify the nearest node by sending the node join request.

Step3: Groups are created between the nodes based on the shortest distance between neighbouring nodes.

Step4: Group count maintained based on the distance between the end node and base station.

Step5: Group heads are created and information about group nodes is provided to the group head.

Step6: Shortest path between the source and destination is created through group heads using AODV Protocol.

Step7: Communication is established over the path created.

Step8: The procedure continues for other source nodes.

The volume of transmitting unwanted path detection messages can be reduced through the use of this method, leading to the ability to control over power consumption.

IV. RESULT AND DISCUSSION

The method is proposed and implemented in NS2 platform. The performance of the network was analyzed by generating xgraphs for throughput, residual energy, packet delivery ratio and the end to end delay. The output of proposed method is compared with the network without successive convex approximation, which is considered as an existing system. Proposed values are plotted as red line and existing is plotted using green line.

Fig. 4. Throughput

Fig. 4. above shows the performance of the network that displays the increasing of maximum transmitted data along with the simulation time. Maximum performance shows successful transmission of data's in the network.

Fig. 5. below represents the residual energy of the network. This graph represents the network lifetime of the network. The graph is compared with dropping of battery power along with the simulation time.

Fig. 5. Residual Energy

Fig. 6 below shows the packet delivery ratio. The increase in PDR shows smaller packet loss in the network. Data transmitted in the network reaches its destination successfully without packet loss.

Fig. 6. Packet Delivery Ratio

Fig. 7 represents the end to end delay between the nodes in the network. The increase in packet delivery ratio, throughput and decrease in the end to end delay show an increase in the performance of the network. Residual energy displays the energy efficiency and network lifetime of the network.

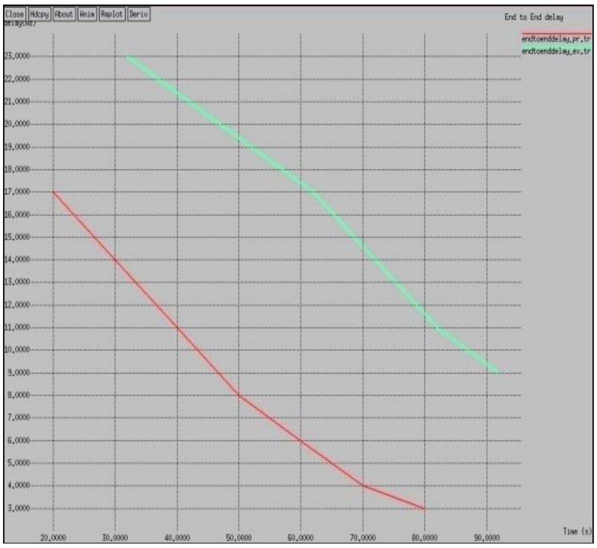

Fig. 7. End to End Delay

V. CONCLUSION

This paper provides us a detailed view of energy efficiency and performance analysis in WSNs. The implementation of successive convex approximation over AODV protocol shows results considered best. Energy efficiency and increase in performance was verified through NS2 simulation and plotted as a graph. Efficient output of a high degree can be seen when this method is implemented in large network.

REFERENCES

[1]. P. Bagyalakshmi and A. Muruganandam, "Successive Convex Approximation with Adaptive Beam Scanning Antenna to Fore Fend Data Collision in WSN", Journal of Advances in Computer Networks (JACN), Vol. 10, No. 1, pp. 10-15, 2022,.

[2]. B. Bejar Haro, S. Zazo, and D. P. Palomar, "Energy efficient collaborative beamforming in wireless sensor networks," *IEEE Trans. Signal Process.*, vol. 62, no. 2, pp. 496–510, 2014.

[3]. Y. Liang, S. Member, W. Zhao, and S. Member, "Energy-Efficient and Robust In-Network Inference in Wireless Sensor Networks," pp. 1–14, 2014.

[4]. C. Karakus, A. C. Gurbuz, and B. Tavli, "Analysis of Energy Efficiency of Compressive Sensing in Wireless Sensor Networks," *IEEE Sens. J.*, vol. 13, no. 5, pp. 1999–2008, 2013.

[5]. A. U. Batmaz, H. U. Yildiz, and B. Tavli, "Role of unidirectionality and reverse path length on wireless sensor network lifetime," *IEEE Sens. J.*, vol. 14, no. 11, pp. 3971–3982, 2014.

[6]. W. Sun, Z. Yang, X. Zhang, and Y. Liu, "Energy-Efficient Neighbor Discovery in Mobile Ad Hoc and Wireless Sensor Networks: A Survey," *IEEE Commun. Surv. Tutorials*, vol. 16, no. 3, pp. 1448–1459, 2014.

[7]. H. Lin and H. Uster, "Exact and Heuristic Algorithms for Data-Gathering Cluster-Based Wireless Sensor Network Design Problem," *IEEE/ACM Trans. Netw.*, vol. 22, no. 3, pp. 1–1, 2013.

[8]. J. Zhao, C. Qiao, R. S. Sudhaakar, and S. Yoon, "Improve efficiency and reliability in single-hop WSNs with transmit-only nodes," *IEEE Trans. Parallel Distrib. Syst.*, vol. 24, no. 3, pp. 520–534, 2013.
[9]. N. Marchang and R. Datta, "Light-weight trust-based routing protocol for mobile ad hoc networks," *IET Inf. Secur.*, vol. 6, no. 2, p. 77, 2012.
[10]. H. Li, Y. Cheng, and S. Member, "Routing Metrics for Minimizing End to End Delay in Multiradio Multichannel Wireless Networks," *IEEE Trans. Parallel Distrib. Syst.*, vol. 24, no. 11, pp. 2293–2303, 2013.
[11]. R. Venkataraman, M. Pushpalatha, and T. Rama Rao, "Regression-based trust model for mobile ad hoc networks," *Inf. Secur. IET*, vol. 6, no. 3, pp. 131–140, 2012.

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