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Energy Efficient AODV Routing Protocol Improvement through LEACH Clustering Mechanism in Wireless Sensor Networks

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ABSTRACT

Wireless Sensor Networks are enormously growing from past decade. Its efficiency and Ad-hoc feature made it as a better solution for data transferring between various mobile nodes. WSN contains sensors to monitor the distributed system and thus paves a gateway to connect between the wired and wireless applications. The whole network consists of sensors, gateways, base stations and nodes that are connected for digital transmission. This paper focus on a prime research area such that the mode of transmission of data in energy efficient manner without time delay and congestion. To achieve the objective a combination of clustering technique and Improved AODV routing protocol is employed and results were determined. Clustering mechanism is used to group the certain node in the network with the fast computation. By this the nodes that are fictitious were easily terminated and active nodes were used to fasten the process. Further an efficient routing protocol was implemented for the robust routing mechanism.The congestion may also occur due to the fictitious node. This is identified with the help of grouping with aggregation. The experimental results were provided and analyzed to show that the combined technique yields better results than the conventional routing protocol.

Keywords: WSN, Clustering, Improved AODV, Routing Protocol, Energy Efficiency, Base Stations, Digital Transmission in WSN.

I. INTRODUCTION

Increasing popularity in smart devices, occupies the mandatory place in day-to-day life. Because of its low-power usage, embedded technology and faster processing computing it becomes an essential computing paradigm of current era. Wireless Sensor Networks (WSN) is the combination or collection of sensor nodes, base stations and connectivity between them. Like Mobile Ad-Hoc networks the WSNs are used in various applications like measuring the heat and humidity at certain environment, physical connection between a wired and wireless component through sensors, collectively to monitor the location and thus providing better solutions.

In WSNs each sensor node consists of a processing capability, multiple typesof memory, RF transceiver, and a power source. In addition, the nodes accommodate sensors and actuators [1]. Figure 1.1, shows the basic structure of the WSNs along with the Sensor nodes and sink nodes. Besides its advantages, however, WSNs are also vulnerable to several threats and attacks. Among these, congestion is a serious form of attack that disrupts and collapses a WSN very deeply. This, in turn, causes tremendous increase in the rate of packet drops and also results in very high

number of unsuccessful packet re-transmissions while data transmission in a network.

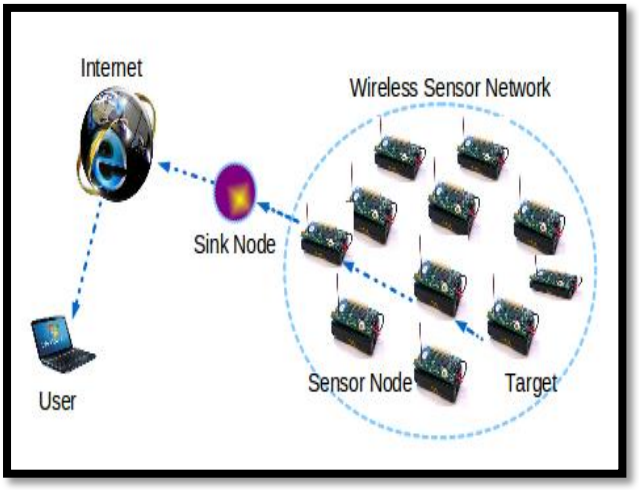

Figure 1. Wireless Sensor Networks

Wireless Sensor Networks are made up of tiny sensors which are used for monitoring or sensing data. Because of their small size, power supply is provided by a small battery, which, when deployed in a 'not-easily reachable' place, cannot be replaced or recharged frequently. The purpose of all these nodes is to monitor the required data and send them to a Base station which may be in a remote place.The sensing nodes, distributed in the environment, are connected to a sink node – in centralised networks – or to other sensing nodes via a network. In centralised networks, the sink collects sensor data to be used by the end user. In many cases, the sink is also capable of activating sensing nodes via broadcasting, by sending network policy and control information.

The Wireless Sensor Networks [2] are deployed in so many areas like vital signal monitoring in tele-homecare systems, ecology monitoring which are widely used for monitoring wild-life, rare microorganisms, changes in the sea or lake water, soil after natural disasters like typhoon, tsunami, flood and soil erosion, monitoring climatic changes, structural monitoring. The Clustering technique is employed in this proposed research work so as to increase the speed of data transmission with less time delay. The algorithm taken into account for the process is the LEACH clustering algorithm. The clustering allows grouping the active nodes, and leaving the inactive nodes untouched and thus transferring the data. The Improved AODV algorithm in turn uses "Energy" as a parameter to find out the better routing to reach the destination. In this research work, the combination of the clustering technique and the Improved AODV algorithm is investigated and the results were determined to reveal the betterment of the data transmission.

Rest of the paper is organized as follows. The section 1 contributes the basic of the Wireless Sensor Networks and the Ad-Hoc Networks Applications. In the section 2, the related research works were discussed in detail. Section 3 brings out the proposed algorithm for the energy efficient data transmission through the combined algorithm and section 4 shows the experimental results gained from the simulations. Section 5 concludes the research work.

II. RELATED WORKS

W. Heinzelman, A. Chandrakasan and H. Balakrishnan invented a technique [3], a Low Energy Adaptive Clustering Hierarchy (LEACH) is omnipresent knowing clustering protocols for Wireless Sensor Networks. Every node is associated with some probability and is used to become a Cluster Head(CH) for each data transformation round, and the main goal of being a Cluster Head is rotated among cluster members. This proposed technique shares communication load sequentially through sensor nodes in the network of networks. However, a single hop routing algorithm does not suitable for the requirements of practical applications.

Lindsey and Raghavendra [4] investigated a chain-based clustering algorithm with Power-Efficient Gathering in Sensor Information Systems (PEGASIS) which as an proposed work for LEACH methodology.

PEGASIS is constructed to decrease intra cluster communication among in hierarchical environment. PEGASIS developing chains with nearest neighbours sensor nodes in greedy trend. A root node is choosefrom each chain to again send the resource to sink node. Similarly LEACH, PEGASIS is also same because these are a single hop routing protocol.

To remains energy consumption through Cluster Heads, [5] introduced non-equality clustering algorithm entitled with Energy-efficient Unequal Clustering (EEUC) to develope the various size of clusters. The size of cluster dependingupondistance from base station and size of the cluster increase with the distance. Thus, the Cluster Heads near to BeamStar preserve some unit of energy for inter-cluster communication. The author also developed an energy aware multi-hop routing algorithm for inter-cluster communication in Energy Efficient Unequal Clustering mechanism. Further, EEUC creates large and various number of Cluster Heads based on parameters like r_{comp}, c etc from round to round and does not guarantee different Cluster Heads for each and every round.

Mao and Hou (2007), [6] presented first edge-based routing protocol for Wireless Sensor Networks. To process the network operations, BeamStar used in the network's infrastructure. BeamStar determines a base station with the way of antenna which contains power control capacity in the network. Such a BeamStar is used to scan the network for produce cite of information to the sensor nodes with different transformation steps in variety beamwidth values. With the cite details, sensor nodes sending the sensed data to the BeamStar using controlled broadcasting technique. The information is transferred using simple forwarding restrictions given by the edge-base station. To transfer the data transmission flooding is used which is not a flexible data deployment technique and will waste of valuable energy informations. To investigates the network health BeamStar transform a wast area of control messages.

Kuong Ho et al. (2009), [7] presented next routing protocol is CHIRON, for edge-based Wireless Sensor Networks. It uses Power-Efficient Gathering in Sensor Information Systems(PEGASIS) to transfer information between the source and sink and, BeamStar algorithm to produce location notifications to sensor nodes. CHIRON performs better than BeamStar with respect to network delay time and lifetime. CHIRON's uses that similar data transmission technique of PEGASIS to provide data. However, CHIRON's data forwarding scheme is not flexible since it transmit data randomly towards destination. Also, raise in network size results in long chain formation and increments the network delay.

Cluster-based BeamStar (CBS), [8] is invented to rectify the disadvantages of BeamStar. Cluster-Based Star uses the same concept of BeamStar to provide location information to sensor nodes, but with a rewind scanning process. Cluster-based BeamStar (CBS) uses network data reliable for inter-cluster communication and scan time.Cluster-based BeamStar(CBS) uses the similar technique of LEACH routing protocol to transfer the data through sensor nodes and a node with higher residual energy will be choosed as a Cluster Heads for each cluster. However, Cluster-based BeamStar (CBS) radius selection paradigm builts large number of rings as the network size grows and congest the network.

III. PROPOSED RESEARCH WORK

The proposed research work is the collective component of the LEACH clustering technique and Improved AODV protocol. When an event occurs, each node in its vicinity sends its reading (the collected data) to their cluster head that performs data aggregation and sends it to the member or the sink nodes. Clustering mechanism is used to group the

certain node in the network with the fast computation. The fictitious node is identified with the help of clustering mechanism. Here the cluster algorithm is not limited with the range/ratio of nodes. This can be used to achieve a simple concept of data transmission with the fast approaching computation

3.1 LEACH Clustering Mechanism

The clustering mechanism allows certain nodes in the network. If the number of nodes used in the application is large, then data aggregation has to be done. If all the nodes try to send the sensed data to the BS(Base Station), more energy will be consumed, eventually more nodes will die frequently. The data gathered by a set of nodes has to aggregated and sent to the BS from that point. A tree like arrangement of wireless sensor nodes is used in this work. All the nearby nodes are grouped to form different clusters.The query will be broadcasted from the node, it will reach only the active (alive) nodes. The interested nodes will then send back the data to the desired node. In turn this will lead to lot of energy wastage, since broadcasting needs lot of energy.

So the cluster based routing is best suitable routing protocol for Environmental monitoring applications. In this work, the clusters are formed based on a weight attached to each node. While forming the clusters, the following rule should be followed- No two clusters should have one or more nodes in interference range. Interference range is that, the two nearest nodes in two different clusters should not be in either transmitting (rt) or receiving state(rr). This will cause interference and overhearing of packets and thereby wastage of energy.

W. Heinzelman, A. Chandrakasan, and H. Balakrishnan. proposed method [9] this idea is inspired from the work of LEACH (Low Energy Adaptive Clustering Hierarchy). In this algorithm, different set of nodes become the cluster heads each time. Every time the node which is the cluster head takes the responsibility of aggregating the data from its nearby nodes and sends the data to the BS, there by reduces the energy wastage of all the nodes. There are also other types of routing techniques available. Most of them are derived from the LEACH.

For all the nodes in each cluster, certain weight (w) is added based on the time, it senses or receives the data from other node. All the nodes in each cluster will wake up based on the weight of the cluster. At that moment the nodes will either send or receive data to or from the other nodes respectively. This weight to the cluster is a group of time slots to all the nodes in that cluster. So in a tree, there will be clusters with different weights. The cluster with greatest weight (smallest time stamp) will be allotted the first available timeslot. Here weight is added based on the information received by the nodes from other nodes and environment. In a tree like structure, the nodes in the clusters have to receive the data from its child nodes and have to send that data packet to the parent node (the node which is in the higher order of the sending node in the tree hierarchy). The time slots will be allocated to the nodes in a decreasing order of weight to the nodes in the tree structure. If this mechanism is followed for scheduling the nodes in a WSN for environmental monitoring applications, surely the overall energy consumption of the WSN can be reduced by a considerable range.

3.2 Improved AODV Routing Protocol

AODV routing protocol is the representative of on-demand routing protocol in MANET and it has become hot spot in recent years. Most of research on AODV are based on default AODV routing protocol. In order to improve the performance of the network which has implemented the improved protocol on it, we use simulation tools to simulate the network and compare the analysis result. Through these results, we can see whether the performance of the network improves or not. There are a lot of examples about improved AODV. The AODV is Ad-hoc On-demand

Distance-vector Routing. AODV is designed for mobile nodes in ad hoc network. It offers quick adaptation to dynamic link conditions, low processing and memory overhead, low network utilization, and determines uncast routs to destinations within the ad hoc network.

In proposed improved AODV routing protocol, to make route more stable and decrease overhead is the prime objective. The achieve this, selecting a node with energy as a parameter is the first step. Every mobile node has an initiated amount of energy. In order to increase the lifespan of the node, it is desirable to take into account the remaining energy. The algorithm route discovery process as follows:

1. Find the energy level of the route and update regularly.
2. Calculate the average route energy and the battery power of lowest charge node.
3. Check the priority of applications.
4. Select the high average energy route for data transmission.

3.3 Procedure for the Proposed Routing Protocol Algorithm

In this section the procedure for the proposed Routing protocol is presented. The active mobile nodes were clustered by using the LEACH clustering technique and passed via the Improved AODV routing protocol. This ends in increased throughput and decreased time delay in the communication network. The following are the steps for the novel algorithm:

Step 1: Selection of the Cluster Head Node and Cluster member/ Sink Nodes.
Step 2: Apply the Sensor networks to identify the active nodes and report it as sink nodes.
Step 3: After the identification of the sink nodes, a cluster group is formed based on the LEACH Clustering technique as explained in section 3.1
Step 4: The Cluster Head in turn consists of the active nodes in every cluster group.
Step 5: The packets are now, transferred through the selected active nodes, to the determined Destination.
Step 6: The Improved AODV routing protocol is now applied for the data transmission, via the selected sink nodes.

IV. EXPERIMENTAL RESULTS

This section shows the simulation results of the proposed algorithm. The figure 2.1, 2.2 shows the Initialization Input address and the Packets to be sent for the destination in multiple nodes. The figures 2.3 and 2.4 reveal the Destination IP Address followed by shorter intervals achieved via the novel proposed algorithm. Figure 2.5 shows the calculation of energy efficiency of each node.

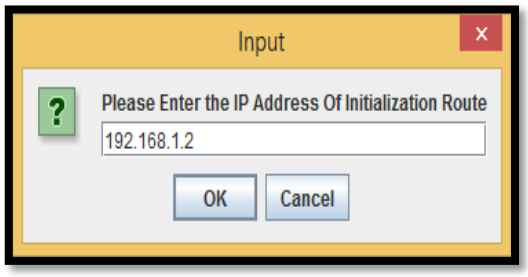

Figure 2.1 Initialized Input IP Address

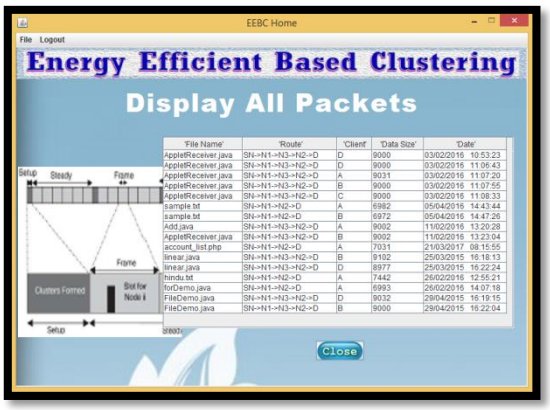

Figure 2.2. Packets available in the active nodes

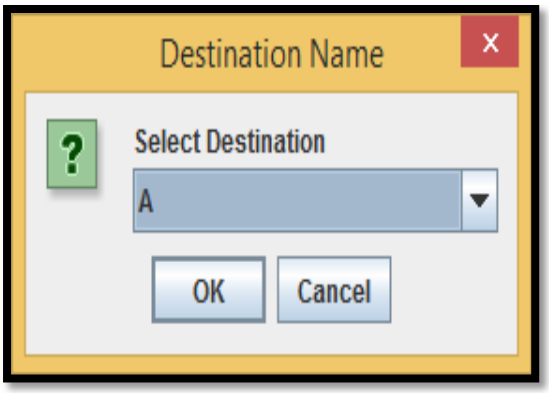

Figure 2.3. Destination Location

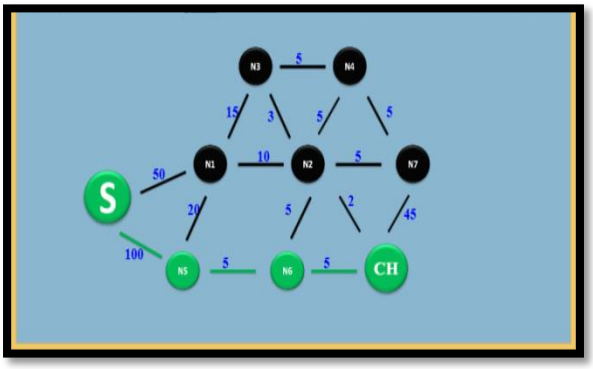

Figure 2.4. Shorter Time Span to reach the destination node

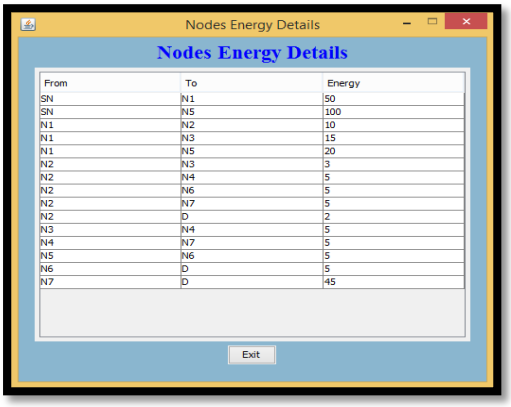

Figure 2.5. Energy efficiency of each node

V. CONCLUSION

In WSNs, power usage is an important factor for network lifetime. In this paper, we have studied the problem of energy efficiency data transmission in wireless sensor network and cluster based data aggregation methods. We are also investigating a degree limit on cluster heads, where the number of sensors subscribing to a cluster head cannot exceed a certain limit. The proposed protocol significantly reduces delay and improves the packet delivery ratio. It also reduces the routing overhead by reducing the frequency of route discovery process.

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