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Enhancement of throughput of DEEC routing protocol in WSN

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ABSTRACT

A WSN is composed of a large number of sensor nodes which consist of sensing, data processing, and communication capabilities. Fault-free and trustworthy data transfer amongst source and destination is the challenges in WSN. The energy efficiency in WSN is a key essential element for improved communication. It is believed that 70% of the energy is used up in data transmission only. The lifespan of the WSN diminishes due to additional energy consumption. Routing protocols as long as providing an optimum data transmission route as of sensor nodes to sink node to save energy of nodes in the system network. Data collection shows a significant part in energy preservation of sensor network. In wireless sensor network energy is mostly used up for three purposes – signal processing, data transmission, and hardware operation. To make the most of the network lifespan data transmission is augmented by applying energy-efficient and reliable routing protocols. The protocols have more traffic overhead and more energy consumption. This thesis proposed enhanced energy efficiency in DEEC routing protocol. The experiment results represented that it also reduced the traffic of the WSN and increases the overall system performance.

Keywords— *DEEC protocol, Energy efficiency, Routing protocols, Throughput analysis, WSN*

1. INTRODUCTION

Recent advancement in wireless communication [1] and electronics has enabled the development of low-cost, low-power multifunctional miniature devices for use in remote sensing applications. A WSN is composed of a large number of sensor nodes which consist of sensing, data processing and communication capabilities. Wireless Sensor Networks (WSN) [2] form a particular sort of wireless data transmission networks. The ultimate remarkable benefit of WSN is that they improved the computation capability to physical circumstances where human presences are difficult. WSNs have been the preferred choice for the subsequent generation for monitoring and control methods. Consistency of WSN is affected by mistakes that may happen due to numerous reasons such as software malfunctions, malfunctioning hardware, dislocation, or environmental hazards. In ad-hoc network batteries [3] can be replaced as and when needed. The WSN protocols are mobility based, location-based, QoS based, data-centric, multipath based, heterogeneity based and hierarchical protocols. Location-based protocols [4] are MECN, GeRaF, BVGF GAF, TBF, SMECH, GEAR, and Span. The energy efficiency in WSN is a key essential element for improved communication. The hardware condition is also good in WSN for better communication. If the channel utilization is more than the throughput of the wireless sensor network reduces. Its drawback is extended delay and little throughput if traffic is more. These features, predominantly provide the perfect information on the position of transmission queues, the outcome in an extremely proficient protocol that, make available the finest performance to handle high traffic in WSNs. Genetic Algorithm (GA) is basically used in optimization problems. In a GA, a population of candidate solutions (known as creatures, individuals, or phenotypes) to an optimization problem is progressed in the direction of better solutions. To each candidate solution takes a set of properties like genotype or chromosomes which can be altered and mutated; usually, solutions are characterized in binary as strings of 0s and 1s, however other encodings may also possible.

The foremost WSN goals are better channel utilization, scalability [5], less power consumption, less node cost, small node size, self-configurability, security, fault tolerance, Qos support and adaptability. The inbuilt battery is the core energy source in the wireless sensor network. Nodes in sensor networks possess very limited energy. The battery power should be sufficient for better performance. The lifespan of the WSN diminishes due to additional energy consumption. Routing protocols as long as providing an optimum data transmission route as of sensor nodes to sink node to save energy of nodes in the system network. Data collection shows a significant part in energy preservation of sensor network.

Furthermore when data collection is carrying out data is compress as it is accepted through the system, accordingly occupying a smaller amount bandwidth. This similarly diminishes the quantity of transmission power consumed by nodes. Henceforth design of energy-efficient [6] and reliable routing protocol can be measured as a very challenging and problematic in a wireless sensor network.

Nevertheless, if the obtainable bandwidth does not maintain exactly the communication necessities, also bandwidth will be unused if nodes have not anything to transmit and queues will be constructed if nodes have extra to communicate than what fits in the distributed slots, leading to extended delays.

2. RELATED WORK

The proposed method [7] used a group of sub-optimal paths sporadically to proliferation the lifespan of the network. These paths are preferred by applying a probability function, which rests on the energy consumption for each path. System network survivability is the key metric that the methodology is concerned with. The approach disputes that using the minutest energy path all the period will diminish the energy of system nodes on that pathway. As an alternative, of one of the numerous paths, is applied with a certain possibility consequently that the entire network lifetime increases. The procedure accepts that for each node is addressable from side to side a class-based method of addressing which comprises the location and categories of the nodes. Diffusion, called Gradient-Based Routing (GBR) [8]. The notion is to possess the number of hops when the concentration is diffused from side to side the network. Henceforth, each node can determine the minutest quantity of hops towards the sink, which is termed height of the node. The dissimilarity amongst a node's elevation and that of the aforementioned neighbour is deliberated the gradient on that node link. A data packet is progressed on a link with the prime gradient.

The author in paper [9], entirely investigated the typical clustering Routing Protocol DEEC and its insufficiencies and suggested improved v-leach. The proposed work to be presented in the improved v-leach protocol on the selection of vice cluster head. The Vice Cluster head is that alternative head that will work simply when the cluster head will expire. And the author makes a comparison of LEACH protocol and improved DEEC protocol. From the simulation results, the author can draw a number of conclusions first: the number of alive nodes is more than the original leach. Second, the number of dead nodes is less than the original leach protocol. The network lifetime is increased as compare to DEEC. Protocols of energy efficiency [10] are established with the objective of improving the energy efficiency of the network. In the recommended system a weight age value is given to these parameters by applying Genetic Algorithm on the outcome. The optimization procedure applied improves the acquired output and assistances obtain the best possible outcome.

The author in [11] suggests employing multiple paths in advance so that in Occasion of a letdown of a path, one of the alternate paths is preferred without any cost for penetrating for another one. There is, of course, the additional overhead of observance these substitute paths alive by applying low data rate, which will unquestionably apply additional energy but added energy can be saved as soon as a path be unsuccessful and a novel path should be preferred.

3. PROPOSED WORK

Step 1: Network system setup phase: Node pick out neighbor's unique identification and broadcasts beacons for network system establishment. Any system node receiving beacons from dissimilar coordinators at the identical instant will be tagged as the alternative gateway node, and the one with the nearest neighbor will be considered as the gateway by coordinators. All coordinators determine the position of their own and neighbors using the gateway.

Step 2: Nodes access period: Afterwards, nodes access to the system, they put on for the allocation time according to step 3.

Step 3: Nodes motion chasing and prediction: Once the node location information directs that the node has at present moved to another network, the recent associated network will report to the target node to standby time slots for the incoming node.

Step 4: System nodes mobility maintenance: If there are buffered data packets in the earlier linked network and when nodes move in a different network, the earlier coordinator would advancing those packets to the fresh node.

3.1 Algorithm

3.1.1 Set-up phase: There are three types of nodes: normal, intermediate and advanced having different energy levels.

(a) Initially, Cluster-heads are selected as in DEEC from the set of intermediate nodes.
(b) After cluster formation, each CH will broadcast a short message containing its ID to find its neighbors.
(c) Each non-cluster-head node from the set of normal nodes determines to which cluster it belongs by choosing the cluster-head that requires the minimum communication energy, based on the received signal strength of the advertisement from each cluster-head.
(d) The selected CH will create a TDMA schedule defining the time slot for each member in its cluster to forward data to it.

3.1.2 Steady-state phase:

(a) Like DEEC all the cluster members (normal nodes) will send data to their corresponding cluster-heads (intermediate node).
(b) Unlike DEEC after aggregation cluster-heads will send the aggregated data to an advanced node which is closer to the BS than the CH. To find such a node CH will compare the distance between an advanced node and BS with that between itself and the BS. Whichever is smaller will be used to transmit data to the BS. If no such advanced node is found then it will send the data directly to the base station.
(c) The advance nodes will again aggregate the sensed data and the data received from the CHs.
(d) After that, it will forward the result to the base station.

3.2 Algorithm

Step 1

a) Initialization step: miniqu=0.20 * qusize
Maxiqu=0.80 * qusize
Warn=qusize/2
Threshold value setup for queue size, packet delivery ratio
Routing protocol setup, Node setup, Scenario setup, Source and destination setup,

b) Each individual node read its congestion status value by using average queue length,
Compute average queue length
The frequency of the data packet is decided according to the congestion status
If the frequency is high then
Ok incoming traffic is low
Else if test packet delivery ratio of the node
Packet distribution ratio dew drop to the given threshold then
Source node randomly choose the next neighbor
If some node response from additional route excluding neighbor node
Then trigger the inverse locating method and send data packets
Marked node as low energy
Activate alarm
Goto End
Else if frequency is low, energy level is also low of node then
Traffic is more, substitute best path is enthusiastically established and
data can be communicated
End if
End

Step 2: Every node directs the location of itself in the system network to its Neighbors.

Step 3: Every node estimates its parameter by applying the GA method based on three descriptors – density, energy and centrality;

Step 4: Every node that has an additional chance than its Neighbors, announce itself as cluster Head nominee to the Base Station (BS);

Step 5: Now BS applying Genetic algorithm method, main cluster heads are determined;

Step 6: key cluster heads are announced to all nodes in the system network;

Step 7: Every sensor node will connect to the adjacent CH

Step 8: Every sensor node applies time distributed to it to communicate data to the CH through a multiple- hop transmission;

Step 9: After all data has been received, the CH performs data fusion function by removing redundant data and compresses the data into a single packet. At that time transmit it to the base station by means of single hops transmission.

In the method, a genetic algorithm is used to determine the place of cluster heads in a way that the minimal amount of energy is consumed. Fitness Criterion is centred on the marginal consumed energy from system network nodes in every group. In the base station, the numeral of nodes that have announced themselves as cluster head nominees determines the chromosome's length in the genetic enhancing method. For each of the chromosome's genes identifies some of the sensor network nodes.

The algorithm description is given in this section. In initialization phase threshold values for queue length, packet number, packet delivery ratio is initialized for parameter testing. The maximum and minimum queue size is set maxq is set as 85% and minqu is set as 15% of queue length. The warning is half the queue size.

Each node checks its congestion status by using average queue length. The frequency of the data packet is decided according to energy status in the network. If the frequency is high then the network is fine incoming traffic is low, no energy problem is identified in the node. Otherwise, check packet number is increases above threshold value then low energy is identified in the node. Otherwise, test packet delivery ratio of the node packet distribution ratio dew drops to the given threshold then very low energy is identified in the node. Source node randomly chooses the next neighbor if some node response from additional route excluding neighbor node then trigger the inverse locating method and send data packets.

4. IMPLEMENTATION

The implementation of the proposed algorithm is represented in this chapter. We have implemented dynamic sub-channel algorithm and multi-channel dynamic slot allocation algorithm.

Table 1: Simulation parameter

Node quantity	100
Area	100x100
Protocol	DEEC
Time	180
Message size	4000 bits
Traffic link	20,8
Max. Speed in m/s	30
Initial energy	0.5J
Eelec	50nJ/bit
Eamp	0.0013pJ/bit/m2
EDA	5nJ/bit/signal

We used MATLAB software for implementation of our proposed algorithm. The experiment was performed in Intel i3 3.5 GHz machine, 4GB RAM. The DEEC protocol is applied for implementation. The implemented results represented that a method improves lifetime, the energy efficiency of WSN.

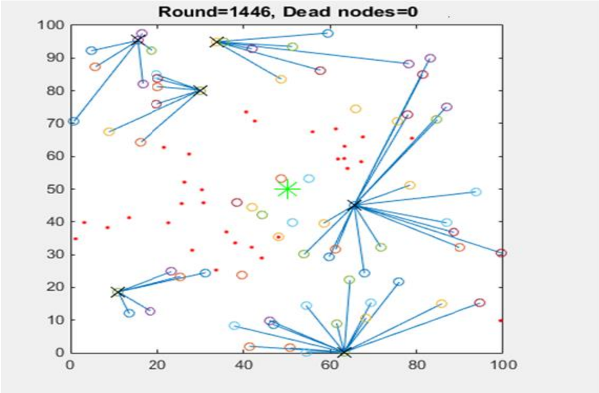

Fig. 1: Dead node status in 1146 round

As represented in figure 1 there are no dead nodes in 1146 rounds. It is represented that our method is more energy efficient than base paper method.

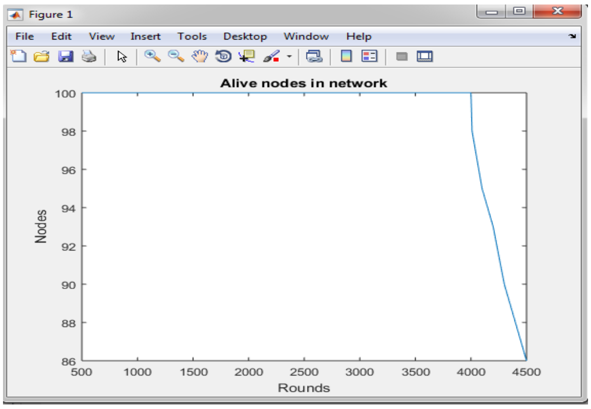

Fig. 2: Alive node status

As represented in figure 2 alive node of networks after each round. It represented that the result is enhanced as compared to the base paper method.

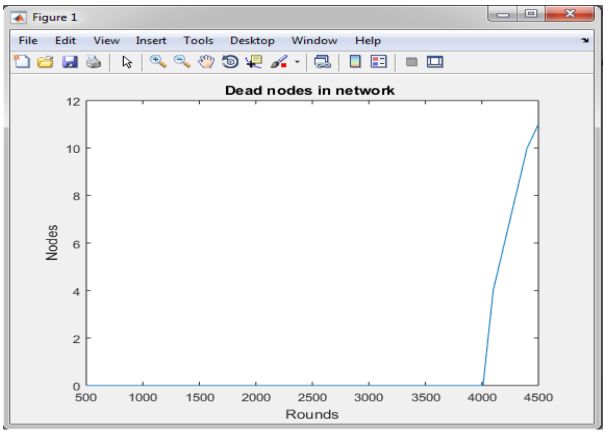

Fig. 3: Dead node status

Figure 3 represents dead nodes in the network after each round. It is represented that the first dead node was accomplished by after many rounds which clearly represents a noteworthy improvement in the lifetime of the network.

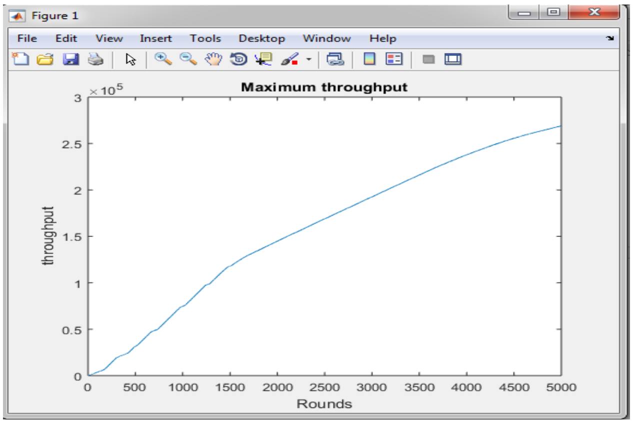

Fig. 4: Troughput status

As represented in figure 4 that the throughput of the system improved as compared to the iQueue method. The figure above represents rounds and their troughput.

Table 2: Result comparison

Methods	First dead nodes
Our method	4000
OSEECH	3500

The table above represents that our method found dead nodes in 4000 rounds which is better as compared to the base method.

5. CONCLUSION

Applications of the wireless channel are on the rise at a remarkable speed. Progress in the energy-efficient scheme has produced new portable devices that empower exciting uses for the wireless channel. While the wireless channel makes the deployment task easier, it adds constraints that are not found in a wired environment. Although, the wireless channel is bandwidth-constrained, and the portable devices that using the wireless channel are archetypally battery-operated and therefore energy-constrained. In addition, the wireless channel is error-prone and time-varying. Therefore, it is important to design protocol and algorithms for wireless networks to be bandwidth and energy-efficient as well as robust to channel errors. The work presented in this dissertation represents an energy-efficient routing technique which is mainly suitable for application like environment monitoring where sensor nodes located in nearby region collect a similar type of data. The protocols have more traffic overhead and more energy consumption. To make the most of the network lifespan data transmission is augmented by applying energy-efficient and reliable routing protocols. The experiment results represented that it also reduced the traffic of the WSN and increases the overall system performance. This thesis proposed enhanced energy efficiency in DEEC routing protocol.

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