Midpoint RED Technique for Cluster head selection in Wireless Sensor Network

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Abstract: Wireless Sensor Networks have been widely considered as one of the most important technique for the collection of data this will be implemented in all industries such as medical, defense, auto-motives etc. Wireless Sensor Networks mainly consists of cluster head connected with all other nodes. The cluster head selection is the main issue in which the energy requirement is exhaustive because of its nature of collecting the data's from all other nodes. The cluster head needs the exhaustive energy so that it can carry the whole network. To solve this problem several algorithms were proposed a new algorithm which is been proposed as Midpoint based Dynamic Energy Efficient Distance Aware Protocol (MBDEEDP). This is energy efficient cluster selection mechanism in the wireless sensor network. The main fundamental is selection of cluster head this is based on the principle of Midpoint-Residual Energy and Distance (M-RED) technique. K-medoid algorithm is used to find out the midpoint of the nodes between the SINK. This algorithm is used to minimize the distance and sends the data rapidly. Fast data transmission has done between CH and SINK. The proposed protocol has been simulated using NS-2 simulator and compared with other existing protocols.

Keywords: Wireless Sensor Network, MBDEEDP, Midpoint-RED, CH, Residual energy and Distance, Clustering, K-mediods.

I. INTRODUCTION

Wireless Sensor Networks (WSNs) is defined as a self-configured and Infrastructureless wireless networks to monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants and to collectively pass their data through the network to a main location or sink where the data can be perceive and examine [1]. A sink or base station acts like an interface between users and the network. One can reclaim required information from the network by introduce queries and gathering results from the sink. Hundreds of thousands of sensor nodes are contain in a wireless sensor network. The sensor nodes can communicate among themselves using radio signals. A wireless sensor node provides sensing and computing devices, radio transceivers and power components. The individual nodes in a wireless sensor network (WSN) are inherently resource constrained: they have limited processing speed, storage capacity, and communication bandwidth [2]. After the sensor nodes are deployed, they are responsible for self-organizing an appropriate network infrastructure often with multi-hop communication with them.

Nodes have been designed for one to one communication among the different applications. A node has been designed based on the applications such as the defense, medical and consumer. It provides the huge applications in the wearable also. It can be integrated in the static environment and mobile environment for the monitoring various applications .since the applications increases, energy consumption increases in the wireless sensor network due to this many energy efficient algorithms were proposed in a wireless sensor network [3].

Clustering mechanism is one of the mechanism which is used to save energy in the WSN's. Clustering deals with the organizations of the sensor nodes into different groups called clusters. In one and each cluster, sensor nodes are given different roles to play, such as cluster head, ordinary member node, or gate way node [4]. A cluster head is a group leader for each cluster that collects sensed data from the different nodes in the network. The data which is gathered from the cluster is passed to the sink for the further processing. The data can be processed from the different nodes to the cluster takes a vital energy in terms of the consumption [5].

In the DEE-M-DA algorithm, energy consumption mechanism for the cluster has been proposed. In which the energy consumption has been achieved based on the distance and the signal strength. The Cluster head selection is based on the M-RED (Midpoint-Residual Energy and Distance) principles. K-medoid algorithm is used to find out the midpoint of the nodes between the SINK. The selection of the cluster is done and energy consumption is compared with the other algorithms like LEACH, DEEDA algorithms.

II. BACKGROUND

Sensors are used to examine and control the physical environment. sensors have limited energy supply and the sensor network is to be expected to be functional for a long time., so optimizing the energy consumption to prolong the network lifetime becomes an important problem.to increase the network lifetime of nodes several algorithms have been proposed such algorithms like LEACH protocol ,Ring routing protocol, and DEEDA Algorithms etc. All these algorithms are used as energy efficient algorithms [6]. LEACH is the first protocol of hierarchical routing which proposed data fusion; it is of milestone significance in clustering routing protocol [7]. Hierarchical protocols are used to reduce energy consumption by aggregating data and to reduce the transmissions to the base station. LEACH protocol is a TDMA based MAC protocol. The main of this is to increase the network lifetime by lowering the energy. LEACH protocol contains two rounds, each round will consist of cluster setup stage and steady phase. LEACH will not give any abstraction about the number of cluster heads in the network. By using this process clusters are divided randomly, due to this energy consumption is increased and network life will be decreases.

To increase the network lifetime another protocol has been come into existence that is a Ring Routing protocol. This protocol is suitable for time sensitive applications. Ring Routing is a hierarchical protocol that is based on a virtual ring structure. This structure is designed easily, it will be accessible and easily reconfigurable. The design requirement of our protocol is to mitigate the expected hotspot problem observed in the hierarchical routing route and will minimize the data reporting delay by considering the various mobility parameters of the mobile sink [8].one of the drawback of this method is more data traffic is concentrating towards the SINK.

DEEDA algorithm will outperforms as energy consumption mechanism for the selection of cluster head. The Cluster head selection is based on the RED (Residual Energy and Distance) principles. DEEDA Algorithms works on two different phases i.e The Phase I deals with the selection of the Cluster head by using the RED principles that is based on Energy and distance. For the selection of cluster heads Rank system is implemented [9]. Phase II deals with the Communication between the cluster head with the other nodes based on the distance.

In the Initial Phase, SINK sends the beacon message to the nodes [10]. Once the nodes receive the beacon message from the sink it calculates the RSSI (Received Signal Strength Indicator) by the formula in this the distance is calculated and the residual energy has been calculated and sent as the frame to the sink. By taking the Highest Rank for Cluster head that is based on the probability and it will be in accordance with two parameters Energy and Distance [11].

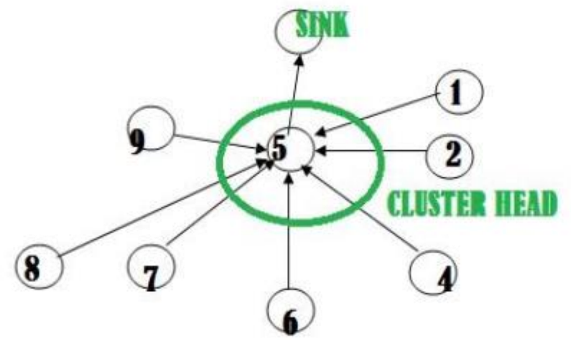

Figure1: Selection of Cluster head: Parameters

The node with the Least Distance and has minimum residual energy, the next least distance will be selected based on the energy by using the RED Principles [12] .In the Decision Phase the Sink decides the Cluster Head Based on the RED Rule Sets which is given as follows

F (C, E) ===\{ F(Et, d) \}

Otherwise 0

Where F (C, E) - Selection of Cluster Head based on Energy

Et-Energy Threshold which is equal to the Maximum Energy

D-least Distance from the Sink to the Node

Mathematical Model: The mathematical model for the different phases is given as follows The Distance is measured depends on the Received Signal Strength Indicator (RSSI) which is given by RSSI (dBm)=-[10×n×log(d)+J] - (1) RSSI is the RSSI value received (dBm) n is the path-loss exponent d is the distance J is the RSSI value at a reference distance (1m) Hence the Distance can be calculated by Distance = 10^[J+RSSI]/(10+n) - (2) RED principles is implemented in the sink to decide the RANK for which the cluster head is selected which is given by the model R(Ch) = Enn > Eth Dnn <Dt Where R(Ch) - Rank of the Cluster head Enn = Energy of the Nodes at Different Distance Eth = Grade of the threshold Energy Dt = Grade of the threshold Energy Dnn = Distance from the Different nodes [13].

In [14], DEEDA algorithm, energy consumption mechanism for the cluster has been proposed. In which the energy consumption has been achieved based on the distance and the signal strength. The Cluster head selection is based on the RED (Residual Energy and Distance) principles. The intelligent selection of the cluster is done and energy consumption is compared with the other algorithms like LEECH etc.

III. PROPOSED METHOD

In previous method (DEE-DA), energy consumption is high because of more distance between Cluster head and sink. Here we addresses the problem of DEE-DA algorithm, propose a Midpoint based Dynamic Energy efficient Delay aware protocol named as

MBDEEDP with parameters as (Midpoint, Residual Energy and distance) M-RED. The primary principle is selection of cluster head is based on our proposed method. Here midpoint calculation depend on K-medoids method. It is used to find out the midpoint of the nodes between the sink.

During the clustering process, the nodes will compare their information with each other and designate the cluster heads. Once the cluster head is selected, then the cluster head node intimates it selection to all the other nodes and remaining nodes join as member. The difference between clustering algorithms are distance and energy. The k-medoids calculates distance between the sensor node and sink node and selects cluster heads.

To address the described issue, proposed approach works by partitioning the System, in each segment and mobile element is assigned. This apportioning contemplates the conveyance of the nodes, to maintain a strategic distance from long separation. Proposed approach begins; by distinguishing the arrangement of nodes, they are used to build mobile elements visits. To acquire these sets, utilization of the collection point based algorithm is proposed. Once the nodes of the visits are recognized, the proposed approach begins by apportioning the system into two segments.

A. Cluster head selection

Though there are various routing protocols based on previous analysis but LEACH is guide for sensor network protocols.

Hierarchical routing aims at making sure less energy is used by sensor nodes by using less number of multi hops in a cluster and to gather data and fuse it in a way to degrade the count of transmitted messages moving to sink as the formation of cluster is dependent on energy saved by sensors and its adjacency to cluster head. Such routing is basically given for wireless networks and are in preference to scalability and effective communication which is used in WSN. Here nodes with higher energy are used for processing and transferring information while nodes with low energy are used for sensing the occurrence of target. The system performance as scalability, lifespan and energy usage are given by clusters and the tasks performed by them. Transmission of data regularly will use more energy hence the task of CH is given to other sensor nodes at regular intervals as to have uniform distribution of energy. LEACH perform in two different stage Steady Phase where data is sent to BS and time taken to transmit is greater than Setup Phase so as to minimize overhead.

Nodes residual energy level as below in equation 1.

$$E(resd) = \sum_{i=0}^{n} E(init) - E(cons) \quad (1)$$

Where E (resd) is Residual energy of nodes; E (init) is initial energy provided to each node; E (cons) is consumed energy of nodes.

The distance can be calculated using Euclidean distance formula like in the Equation (2)

$$\sqrt{(x_j - x_i)^2 + (y_j - y_i)^2} \quad (2)$$

Post calculation of values as in Eq^n 1, 2, the nodes elect the CHs among them which spread an advertisement to non-CHs to form a cluster. A non-CH chooses a CH that can be reached expending the least energy for communication.

<u>Algorithm:</u> Cluster Head Selection-CHS

Step1: select initial medoids

1.1 Using Euclidean distance as a dissimilarity measure computes the distance between every pair of all objects as follows:

$$\left\{ d_{ij} = \sqrt{\sum_{a=1}^{p} \left(X_{ia} - X_{ja}\right)^2} \;\; i = 1, \ldots, n; \; j = 1, \ldots, n \right\} \quad \text{Eq.(1)}$$

X_{ia} ------→ first point (x-topology) representation

X_{ja} ------→ second point (y-topology) represenation

a--→ initial value

p---> ending value

d_{ij}-→ euclidean distance

1.2 Calculate P_{ij} to make an initial guess at the centers of the clusters.

$$\left\{ P_{ij} = \frac{d_{ij}}{\sum_{l=1}^{n} d_{il}} \; i = 1, \ldots, n; \; j = 1, \ldots, n \right\} \quad \text{Eq.(2)}$$

P_{ij} --→ medoid point

1.3 At each object, calculate $\sum_{i=1}^{n} d_{ij}$ $(j = 1, \ldots, n)$ and arrange them in ascending order. Select k objects as initial group medoids which are having the minimum value.

1.4 Set to the nearest medoid for each object.

1.5 Determine the sum of distance from all objects to their medoids i.e., the current optimal value.

Step2: Find out new medoids

The current medoid which minimizes the total distance to other objects in its cluster is replaced by the object in each cluster.

2.1 To the nearest new medoid, each object is

To address the exhibited issue, we display proposed approach that works by partitioning the System, and then in each segment, a mobile element will be assigned. This apportioning contemplates the conveyance of the nodes, to maintain a strategic distance from long separation going by the mobile element. Our approach begins by distinguishing the arrangement of nodes that will be utilized to build mobile elements visits.

IV. EXPERIMENTAL RESULTS

In this paper, we assume that 21 sensor nodes are randomly distributed over a 1000x500m^2 field. In this paper, we accept that no gap exists in the detecting field and static sensors are the same in their abilities. In the meantime, we accept that the sink is located in the mid-point of network. Table1 shows the system parameters used in our simulations. In this paper, in order to simplify scheduling for cluster head selection, we accept that the information gathered by sensor nodes is the deferral tolerant information. Here we used 512 bytes and 1024 bytes for each transmission process. The simulation of our network process is 25 secs. The number of nodes we consider as 21.

PARAMETER	VALUE
Application Traffic	CBR
Transmission rate	512 bytes/0.05ms
Radio range	250m
Packet size	512 bytes,1024 bytes
Maximum speed	30m/s
Simulation time	25s
Number of nodes	21
Routing Protocol	AODV
Area	1000x500
Routing methods	M-LEACH, DEEDA, MBDEEDP

Evaluation results:

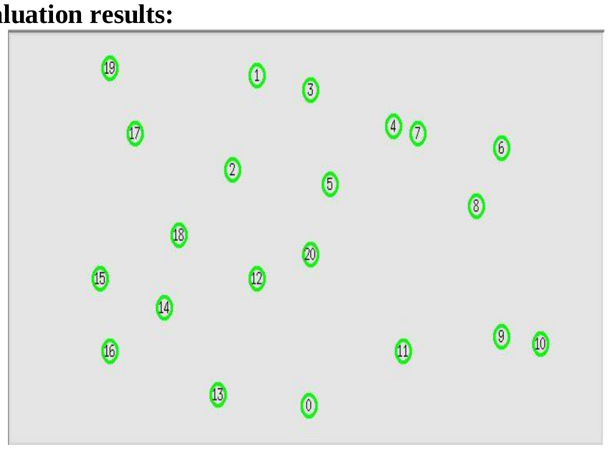

Figure2: Network deployment

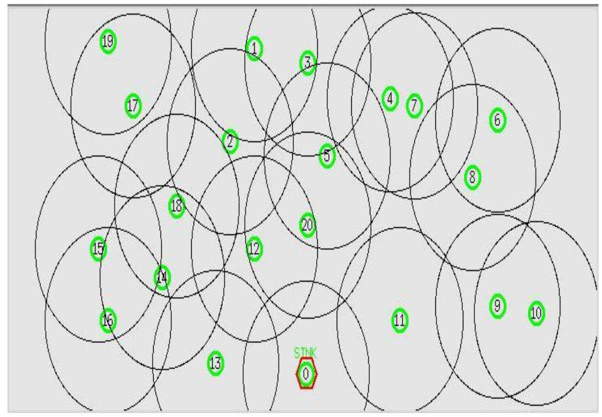

Figure3: Broadcasting process in network

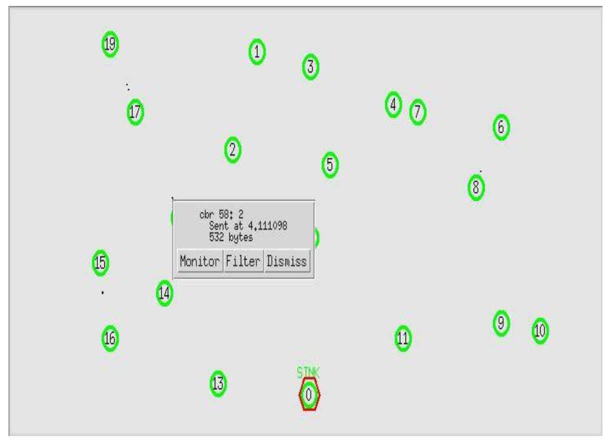

Figure4: data transmission between cluster member and head

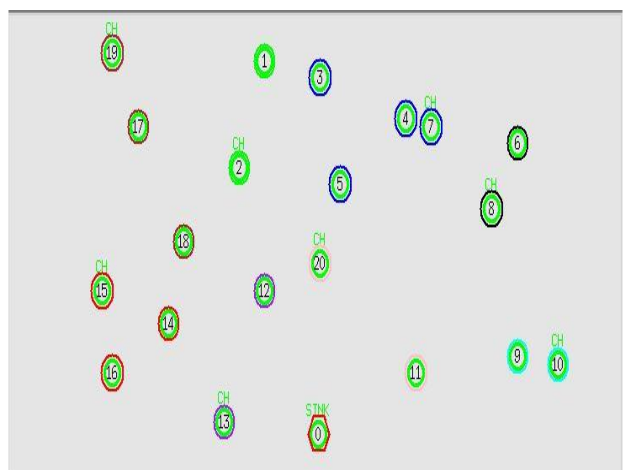

Figure5: Displayed all cluster heads in network

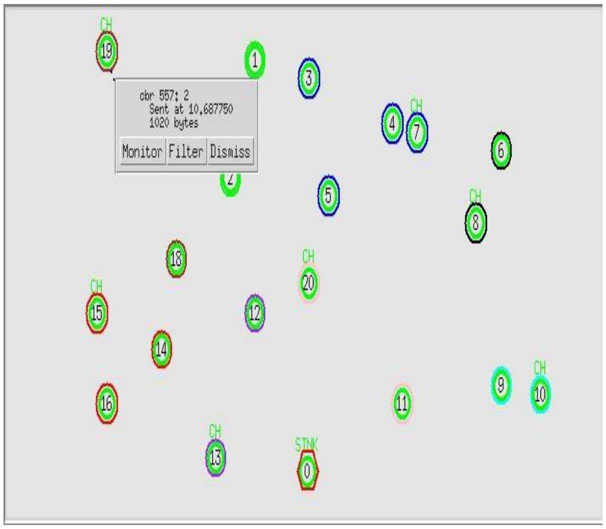

Figure6: data communication starts from cluster head

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Cluster Formation at 19.799851
Cluster - 1 : 14 15 16
Cluster - 2 : 12 13
Cluster - 3 : 11 20
Cluster - 4 : 9 10
Cluster - 5 : 17 18 19
Cluster - 6 : 1 2
Cluster - 7 : 3 4 5 7
Cluster - 8 : 6 8

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Midpoint of node 14 to BS (160 , 210)

Midpoint of node 14 to BS (180 , 145)

Midpoint of node 14 to BS (130 , 155)

Energy of node 14 99.800439
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Distance from node 14 to its neighbour  14  15  16
 0.000000  136.014705  125.299641
Midpoint of node 15 to BS (180 , 145)

Midpoint of node 15 to BS (200 , 80)

Midpoint of node 15 to BS (150 , 90)

Energy of node 15 99.810610
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Figure7: Selection of cluster heads based on M-RE-D parameters

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Midpoint of node 12 to BS (200 , 400)

Midpoint of node 12 to BS (120 , 360)

Energy of node 12 99.776353
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Distance from node 12 to its neighbour  12  13
 0.000000  178.885438
Midpoint of node 13 to BS (120 , 360)

Midpoint of node 13 to BS (40 , 320)

Energy of node 13 99.787337
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Distance from node 13 to its neighbour  12  13
 178.885438  0.000000

Cluster Head(CH) is node : 13
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Midpoint of node 11 to BS (100 , 700)

Midpoint of node 11 to BS (166 , 605)

Energy of node 11 99.855896
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Distance from node 11 to its neighbour  11  20
 0.000000  231.924557
Midpoint of node 20 to BS (166 , 605)
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Figure8: calculation process of CH

In figure 2, it represents the Network deployment. Where all nodes are deployed first in the initial stage. In figure 3, it represents the Broadcasting process in network after the deployment of nodes in the network. Checks the whether the node is present or not in its range. In figure 4, it represents the Displayed all cluster heads in network, after formation of the cluster, next cluster head is selected based on shortest distance, residual energy and mid-point. In figure 5, it represents the Data transmission between cluster member and cluster head, here cluster members sends the data to cluster head. In figure 6, it represents the Data communication starts from cluster head. After the data is received from the cluster members, cluster head transfer the data to SINK or base station. In figure 7, it represents the Selection of cluster heads based on M-RE-D (Mid-point, Residual energy and Distance) parameters. In figure 8, it represents the Calculation process of CH. Based on the above parameters the CH is selected.

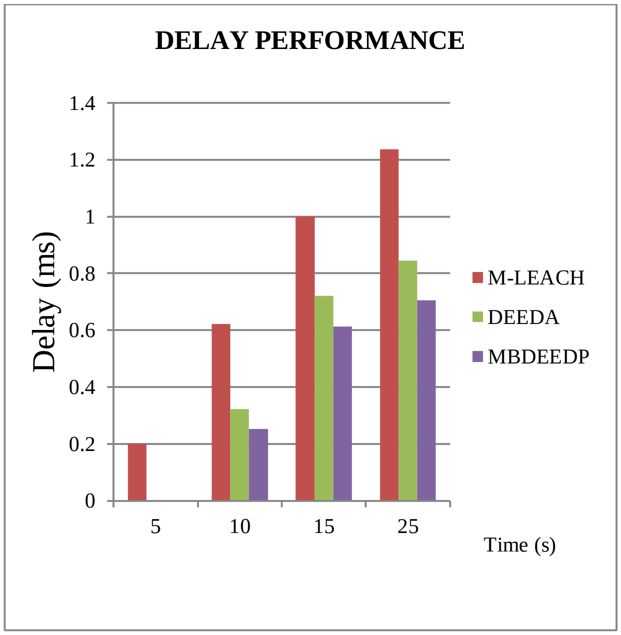

Figure9: Performance on Delay

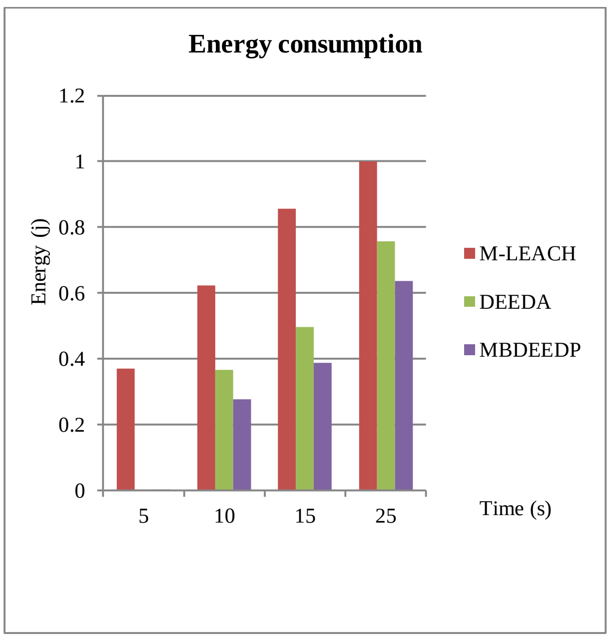

Figure10: Energy consumption

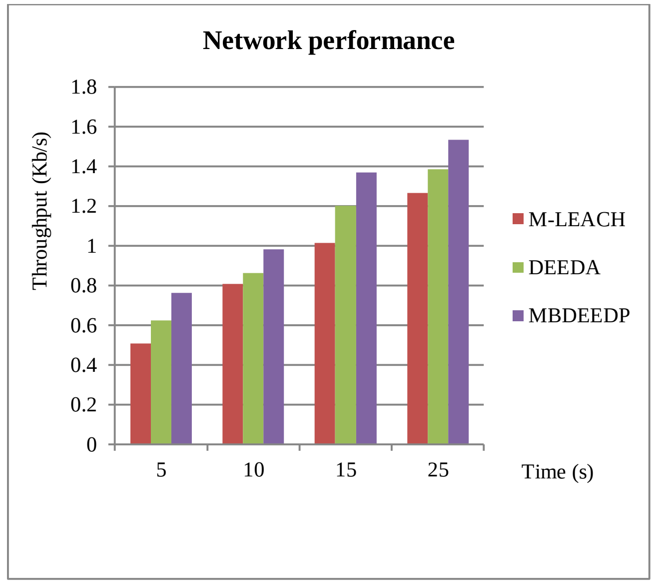

Figure11: Network performance

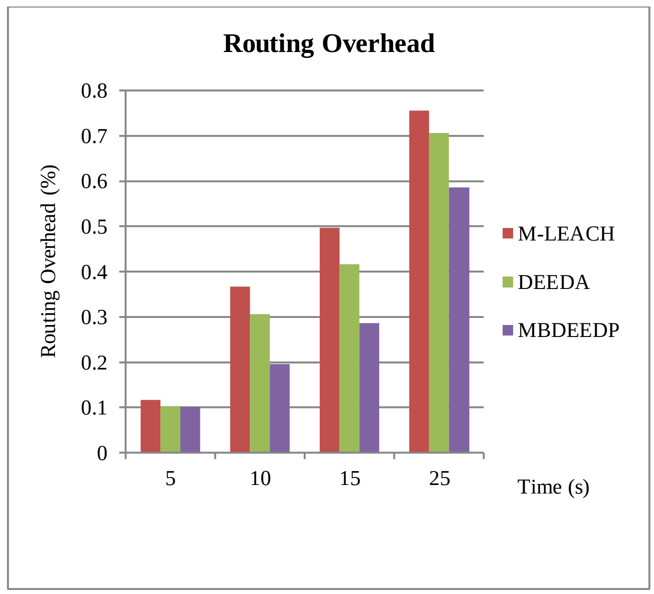

Figure12: Routing overhead

In figure 9, it represents the End-to-End Delay. In the network, we reduce the delay by proposing our work i.e., MBDEEDP and it performs well will comparing with the existing works like DEEDA and M-LEACH. In figure 10, it represents the Energy Consumption. We reduce the energy consuming in the network, by proposing our work i.e., MBDEEDP and it performs well will comparing with the existing works like DEEDA and M-LEACH. In figure 11, it represents the Network Performance. In the network, we increased the throughput by proposing our work i.e., MBDEEDP and it performs well will comparing with the existing works like DEEDA and M-LEACH. In figure 12, it represents the Routing Overhead. We reduce the routing overhead in the network, by proposing our work i.e., MBDEEDP and it performs well will comparing with the existing works like DEEDA and M-LEACH.

V. CONCLUSION

MBDEEDP Algorithm outperforms in terms of Energy Saving and energy consumption of the Cluster Head when compared with the existing algorithms DEEDA and M-LEACH. The proposed algorithm can be integrated for increase in lifetime of the nodes. In addition, it can be implemented along with the Energy harvesting mechanisms for the increased lifetime and performance of the system. The experimental results done through network simulato-2.

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