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Framework with Enhanced Routing algorithm for Mobile Sensor Network

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Abstract: Mobile sensor network is subgroup of wireless mobile sensor networks, in which each node are mobile in nature. In heterogeneous sensor network, the network mobility is unpredictable. Routing in mobile sensor network is major challenging with various real time applications. Sensor nodes are mobile in nature, data transmission and data reception process incur packet loss, delay on delivery, packet delivery ratio and energy depletion. To overcome this problem Cluster based routing technique introduced and simulated to acquire. This paper explains about the clustering based routing algorithms in Mobile Sensor Networks that have been proposed earlier by the authors in different journals and further compares the packet delivery rate, energy consumption, latency delay and packet loss of the network based on time interval. This paper analyses the result based on existing routing algorithms like Enhanced perimeter forwarding algorithm (EPFA), partial partitioned Greedy Algorithm (PPGA), Enhanced Efficient routing algorithm (EERA) Mobile Wireless Sensor Networks. Above routing algorithms to be analyzed with set of sensor nodes, simulation results shows an ultimate solution to Mobile Sensor Networks

Keywords – Mobile sensor network, Clustering, Mobility, Energy Efficiency

1. INTRODUCTION:

Mobile sensor network is framed with sensor nodes with different speed of mobility. Mobility factor is changed from to time for a need of a virtual applications. Nodes deployed in randomly, with limited computational capabilities. MSN networks since these networks usually operated in only partially unknown and unpredictable environments with dynamic network structure. Connectivity control, formation control, rendezvous, and coverage control are the usual parameters for mobile sensor network.

This paper has been orchestrated as follows. Section I gives introduction on Mobile Sensor Networks. Section II describes the cluster based routing technique. Section III describes literature study on relevant routing algorithms. Section IV explores the performance analysis of routing algorithms. Section V specifies the conclusion.

2.LITERARURE REVIEW:

According to author routing a mobile nodes are deployed random manner, in these nodes are adapting the frequently changing the climatically conditions. The node coverage and node mobility [1] is the highly challenging to perform routing functions. Intra and inter cluster based routing in Large area WSN, where are analyzed with node mobility and energy factor.

An Optimal Routing with Node Prediction (ORNC) algorithm [2] proposed by the author for the mobile node to improve the routing on mobile network. ORNC algorithm routing is carried out by Node classification, calculating the trust factor, and calculating fitness functions.. Whereas the node classification is based on node initial energy and memory it categorized 4 different types. Based on the Boolean operators AND/OR operators we calculate the trust values. These trust value gives the best path from the n number of from source to destination, so the routing ids performed in an efficient manner.

An inter cluster based routing algorithm is proposed by the author, in the mobile sensors energy consider as major research factor. This proposed work follows certain cluster head selection policy [3]. The sink node is monitored and other parameters are materialized with packet delivery ratio, latency and energy. In CFMS algorithm[3] proposed with mobile nodes, to perform routing on intra and inter cluster based sensor network. The cluster are formed with Directed acyclic graph in intra cluster. In inter cluster node are formulated by the tree structure so that data aggregation is performed in better way, co that delay is reduced substantially. Load balancing is applied while routing so that routing over head is reduced, ultimately the packet delivery ratio is improved.

The propose work Elham Ghorbanifar focus the energy factor of the sensor network[4], whereas concentrate the end to end delay and network life time, the algorithm is executed in the intra cluster based sensor network.

Whale optimization algorithm and tunicate swarm algorithm (TSA) are combined to form whale tunicate swarm algorithm (WTSA)[5], is deal with the multipath routing in Sensor network. Both intra and inter cluster based distance, node degree and energy are the parameters are taken into evaluation of WTSA. A proposed methodology improves the throughput reduces delay.

Then black widow optimized routing protocol[6] find the optimal path to transmit the data with received signal strength indicator (RSSI).In order to create a manual cluster on the network, this task is suggested with a reference node, which lowers the energy used by the cluster head compared to

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alternative models. By taking into account congestion and retransmission, which cause the node to lose energy, the reference node determines how many paths are available for the mobile node to transfer the data. This model improves the packet delivery ratio and reduce delay time.
In Modified Ring Routing protocol performs routing in inter cluster based mobile sensor network, here the CH selection based on the residual energy. Each node is connected to its neighbor node with one hop neighborhood list. The sink node is the neighbor of the relay node in ring the corresponding node in the circle performs the routing. Modified Ring[7] Routing Protocol for Mobile Sinks in a Dynamic Sensor Network in

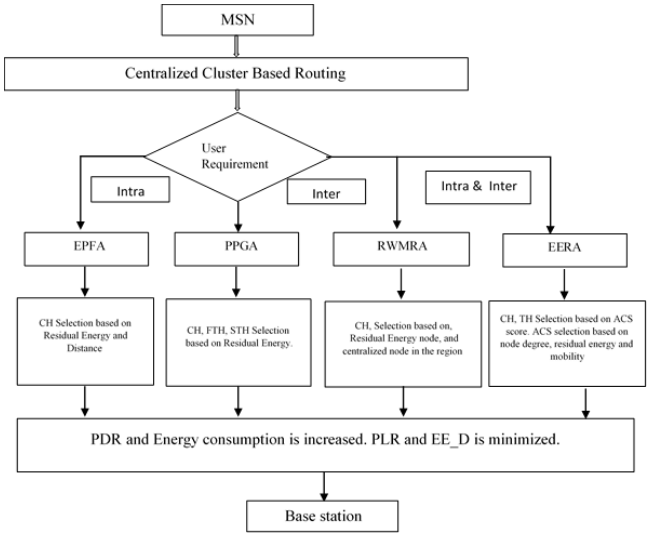
Smart Monitoring Applications.

2. ROUTING ON MOBILE SENSOR NETWORKS:

In mobile sensor network routing is get into clustering of sensor region segmented into n number of overlapping groups. Each group is governed by a node referred to as Cluster Head (CH) with all the nodes within a cluster referred to as Cluster Members (CM). Cluster Head (CH) collects the data from all the member nodes and aggregates the data collected from the member nodes and sends it to the Base Station.

Cluster based routing used to is used to reduce the energy consumption among the sensor nodes thereby increasing the lifetime of the nodes. In Mobile Sensor Networks various cluster based routing algorithms have been proposed. The ultimate aim of all these proposals is to improve the packet deliver ratio, reduce energy consumption, delivery delay and packet loss of network.

From the papers EPFA, PPGA and EERA is analyzed in various routing parameters in which the node density of 120 nodes in dynamic environment, in which various results of the 4 contributions given the ultimate result of the objective is well defined way.



3. RELATED WORK

3.1. Enhanced Perimeter Forwarding Algorithm: EPFA

Enhanced perimeter forwarding algorithm proposed to a cluster region with restricted number of sensor nodes. EPFA [2] is a Cluster based routing Algorithm which improves throughput and reduce energy consumption, packet delay, packet loss Mobile Sensor Networks. EPFA algorithm is designed for the nodes which change the mobility from time to time. It could to restrict to region with radial distance r. The algorithm checks for node existence within the region, data transmission taken carryout by either single hop or may be multi hop fashion. Node degree is determined by one hop neighbors within a transmission range. The distance between the node and the base station, the node's mobility and the energy used in data transmission and reception are all calculated. The node with maximum residual energy is selected as Cluster Head. Once the Cluster Head (CH) is selected the remaining nodes sends a Request to the CH to become a Member to form the Cluster. The nodes which receive an Acceptance message from CH becomes the Cluster Member to form a Cluster. The weight of each node is calculated and the node with maximum weight is considered as the Cluster Head for the regular time interval seconds. As the Cluster is formed the Cluster Members sends data to the Cluster Head which are aggregated and forwarded to the Base Station. Throughput is increased in a Cluster region, when it is compared with CCM_GR Algorithm.

ALGORITHM 1 : SELECTION OF CH

1. Nodes n1, n2, n3..... $\propto$ are the nodes within the network range and forms as a cluster.
2. The density of the network is defined as θ and $\theta = \frac{S^2}{N}$, where S^2 is the area of the Network, N is the number of nodes.
3. All member nodes communicates the information about its current energy and locations to its CH in each
4. The energy value of each node can be calculated and the highest energy node will be selected as a CH.
It acts as a superior in all the clusters.

If N = n1,n2,n3.... $\propto$.} then CH >n1,n2,n3..... $\propto$.

ALGORITHM 2 : SUB-REGION SELECTION AND FORWARDING ALGORITHM

1. Input Neighhop_List, WaitList
2. Add component in WaitList to Neighhop_List
3. For i<NeighHop_List length do
4. Get the area of next hop j
5. if dis_to_nexthop > T r
6. Store j into WaitList, n=0
7. Else
8. Call DivedeSubForwardRegion(List NeighHop_list)
9. End if
10. Call SelectNextHop(List NeighHop_subregion)
11. End for
12. Judge n whether still in NeighHop_list, if not n=0
13. Output n
14. Capacity DivdeSubForwardRegion(List NeighHop_list)
15. Cross the whole NeighHop list
16. Partition these NeighHop into various districts with equivalent region
17. Calculate the normal vitality of each sub-locale ir E
18. Select the greatest the ir E

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19. Return the relating rundown of NeighHop_Subregion with greatest ir E
20. End Function

3.2 Partial partitioned Greedy Algorithm: PPGA

Partial-partitioned Greedy Algorithm (PPGA), for mobile sensor networks that consist of frequently moving sensors. PPGA algorithm partitions the sensing field into radial distance r. Each have its mobile sensor nodes with regular time interval. The protocol uses the location information of sensors and the base station to assign a cost function to each sensor node, which is close to the Euclidean length of a sensor node's shortest path to the base station. A packet is forwarded to the base station using greedy forwarding whenever possible. When a packet reaches sensor nodes near local minimums, where greedy forwarding will be impossible after a number of hops, the packet is forwarded following the high-cost to low-cost rule. The node with maximum residual energy is selected as the Cluster Head. The next lower nodes is get elected as transmission Head, and next lower energy node is elected as subordinate cluster head. The other nodes sends a request to the respective Cluster Head and the nodes become Cluster Members as it receives the Acknowledgement from the Cluster Head. Head's to clusters are formed for regular time interval t. As the nodes are in mobility, the nodes move from one cluster to the other, thereby joining the new Cluster. New Cluster Heads are re-elected whenever the Cluster Head leaves the cluster. Similarity the remaining heads get into re-elected for the each time interval t.

The algorithm shows a better performance when compared with EPFA with improves packet delivery ratio, reduces the delay, packet loss and energy. The Energy Consumed during mobility is also less compared to EPFA. PPGA is a Cluster based routing Algorithm which maximize packet delivery ratio, reduce latency delay, packet loss and energy consumption for the Mobile Sensor Networks.

Cluster Head Selection Algorithm ( )

Start_CH_SelectionAlgorithm()
1. singclusweight=w1×E+w2×I
2. isclusterhead=1
3. maxweight=singclusweight
4. timer=1/singclusweight
5. if (timer<0)
6. CH_Announcment(myID,singclusweight)

ReceiveAnnouncment (SNid, weight)

1. If (isclusterhead==1){
2. If(ownweight<weight){
3. isclusterhead=0
4. MyCH=SN id
5. maxweight=weight}}
6. else if(isclusterhead==0){
7. If(maxweight<weight){
8. MyCH=SN id
9. maxweight=weight}}

3.3 Random Waypoint Mobility Routing Algorithm: RWMRA

In RWMRA proposed to high mobility applications, in which the sensor nodes are deployed randomly. Sensor regions are divide into rectangle region. Region head is get based on the residual energy of the nodes in each region. The highest residual energy node is elected as cluster head. Distance between the nodes to its cluster head is for data forwarding. Node degree is calculated by either clock wise or anti-clock wise from the location of the node in a region.

Algorithm 1: Region Creation

1. Randomly deploy sensor nodes.
2. Partition the sensor field into D regions.
3. Select center point and corner points
4. Create region head (SSN) based on selected region
5. Draw circle based on the selected points using radius r_{comm}
6. For each node in Network
7. Get node location n(x,y)
8. For each region in Network
9. Get the location of ssn(x,y)
10. Compute the dist(x,y) = n(x,y) - ssn(x,y)
11. If (dist (x,y) ≤ r_{comm})
12. Set node n coverage = Yes
13. break;
14. Else Set node n coverage = No
15. EndIf
16. EndFor
17. EndFor

Algorithm 2: Announce Mobile Sink Location

1. if distance(dest(x, y),C(xc, yc)) ≤ r1 then
2. send a destinfo_MSG in the opposite direction of the network center
3. else if distance(dest(x, y),C(xc, yc)) ≥ rk then
4. send a destinfo_MSG towards the network center
5. else
6. send two destinfo_MSG; one towards the network center and one in the opposite direction of the network center.
7. for each node receiving destinfo_MSG do
8. if Node i : type == normal sensor node then
9. Ignore the destinfo_MSG
10. else
11. if (Previous destination location != Current destination location) then
12. Save the destination location information, share destinfo_MSG with its clockwise and anti-clockwise neighbouring VS nodes, and other region.
13. stop sharing destinfo_MSG
14. else
15. send the destinfo_MSG to its next neighbouring VS node
16. Ignore the destinfo_MSG

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Algorithm 3: Data Transmission

1. compute the distance between X and Y at interval time t

$$dis^{X,Y}(t) = \| X_{loc}(t) - Y_{loc}(t) \|$$

2. if dis X,Y(t) ≤ r_{comm}
(Node X is within the transmission range of Node Y) then
3. NS = Get node status ()
4. If (NS == Coverage)
5. Transmit Data
6. Else If (NS == Non Coverage)
7. Exit routing
8. Else If (NS ==Move)
9. Wait until Node movement
10. Else (Node X is not in the transmission range of Node Y)

// Use Node Y nearest SSN to Compute

11. D1= || SSNloc (t) – Yloc (t) ||
12. D2 = || SSNloc (t) – Yloc (t+1) ||
13. DC = ||D2 – D1|| / D1
14. θ = || θ (t+1) – θ|| / 2π
15. mob = α. DC + β. θ (Where α and β ϵ [0, 1])
16. Find the path based on mob
17. Check all nodes (path) mobility status
18. Update the pause time of node
19. Transmit data

3.4 Enhanced Efficient Routing Algorithm: EERA

EERA is propose for the mobile sensor network it will applied with high mobility environment. In this algorithm is calculates cumulative credit score based on sensor node is energy, mobility and neighborhood node. Based ACS is each region the Cluster head is selected. The next ACS node get elected as the TH.

Algorithm 1: Cluster formation ( )

N nodes randomly deployed in L*L region
Sensor nodes segmented into n clusters with radial factor r
Min_energy = 5 jules
For i = 1 to n do
SN_energy(i) = 30 jules
SN_mobility(i)=

$$\frac{SN\_current\_position(i) - SN\_previous\_position(i)}{time\ interval\ t}$$

Endfor

Procedure Neighbour(t,n,r,Θ)

Let t=200 rounds
For i = 1 to t do
For j= 1 to n do
For k= i+1 to n do
If (SN_neighbour[i]&&SN_neighbour[j][k] ≠ NULL) then
count_neighbour+=1
Endif
Endfor
Endfor
Endfor
Return(count_neighbour)

Procedure Energy(SN, n)

For i=1 to n-1 do
For j=i+1 to n do
if (SN_energy[i]>SN_energy[j]) then
temp_node = SN_energy[i]
SN_energy[i] = SN_energy[j]
SN_energy[j] = temp_node

Endif
Endfor
Endfor
For i=1 to n do // CH and TH selection for n clusters

return(SN_energy[i])

Procedure Mobility (SN, n, t)

For i= 1 to n do
SN_mobility[i]

$$= \frac{SN\_current\_position[i] - SN\_previous\_position[i]}{time\ interval\ t}$$

For i=1 to n-1 do
For j=i+1 to n do

if (SN_energy[i] < SN_energy[j]) then

temp_node = SN_energy[i]
SN_energy[i] = SN_energy[j]
SN_energy[j] = temp_node

Endif
Endfor j
Endfor i
For i=1 to n do
Return(SN_mobility[i])

Algorithm 2: Selection of Cluster head and Transmission head (N, SN_energy, SN_mobility)

1. For i= 1 to N do // for all nodes
2. Assign CH=TH=NULL
3. If (SN_energy(i) > Min_energy and SN_mobility(i)< 20) then
4. CH=SN_id(i)
5. Else
6. For i=1 to n-1 do
7. For j=i+1 to n do
8. if [SN_energy(i)>SN_energy(j)] then
9. temp_node= SN_energy(i)

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10. SN_energy(i)= SN_energy(j)
11. SN_energy(j)= temp_node
12. Endif
13. Endfor
14. Endfor
15. Endif
16. For i=1 to n do // CH and TH selection for n clusters
17. CH= SN_id(i)
18. TH= SN_id(i+1)
19. Endfor
20. Endfor

Algorithm 3: Path Announcement (SourceSN_id, SinkSN_id, CH,TH,SN_energy, Θ)

1. t = 200 round
2.Path = null, Tot_time=t // Total time for simulation
3. Do
4.For k = 1 to Tot_time // Time interval for N nodes
5.If (SinkSN_id ≠ null) then // check sink node is availability
6.For i=1 to n do //all nodes in each cluster
7.If (SinkSN_id == neighbour(CH[i])) then

8. TH=path(x,y, with its clockwise and anti-clockwise to the cluster)

9. Else if(SinkSN_id == neighbour(CH[i+1])) then

10. TH=path(x,y, with its clockwise and anti-clockwise to the cluster)

11. Endif
12.Endif
13.Endfor
14.While (Tot_time >t)

Algorithm 4: Procedure pathMaintanence (SSN_id, Sink _id, CH, TH)

1. Path = null

2. Tot_time = t // Total time for simulation

3. Do

4. If (CH || TH == NULL) then

// due to mobility check CH/TH availability

5. Call Procedure Selection_CH/TH( )
6. While (Tot_time > 60)

4. PERFORMANCE ANALYSIS OF ROUTING ALGORITHMS:

The performance of Cluster based routing Algorithms are analyzed. Overall throughput of the Algorithms are analyzed along with the packet delivery ratio, Energy, packet loss and end to end time delay during predefined time intervals. The performance of the various algorithms are analyzed in Matlab 7.0.

The overall Energy Consumption of all the Clusters and the Energy Consumption based on the Mobility of the Nodes are also analyzed.

Table 1 shows the overall Packet delivery ratio of the clusters during Round 200 Rounds at sensor regions.

Rounds	Packet Delivery Ratio			
	EPFA	PPGA	RWMRA	EERA
1	1	1	1	1
50	0.702	0.674	0.692	0.702
100	0.716	0.688	0.706	0.716
150	0.704	0.714	0.72	0.704
200	0.74	0.678	0.7106	0.74

Table 1 : Packet Delivery Ratio Vs No of Rounds at Regions

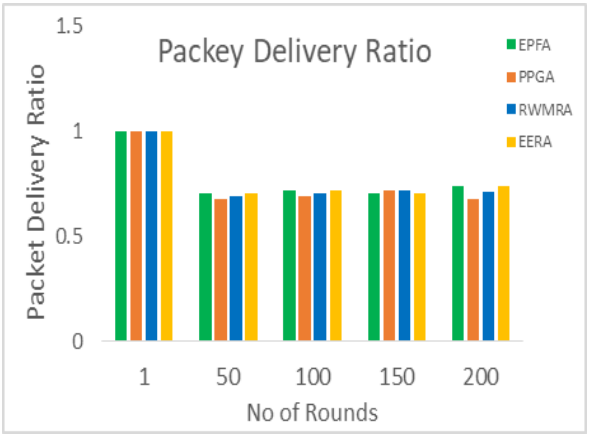

Fig. 1: Packet Delivery ration Vs Time interval at Regions

Fig. 1 shows the Packet Delivery Ratio of the Clusters is more reduced at 50 rounds in EPFA, PPGA, RWMRA and EERA algorithm.

The packet Delivery Ratio of Clusters is almost same in EPFA and EERA in 100 rounds.

PPGA and EERA give the same packet delivery ratio at 150 rounds when it compared with EPFA and RWMRA.

Rounds	End to End time Delay			
	EPFA	PPGA	RWMRA	EERA
1	0.1	0.1071	0.0787	0.0947
50	0.152	0.131	0.1018	0.1085
100	0.181	0.16	0.1177	0.1104
150	0.19	0.213	0.14001	0.1239
200	0.21	0.256	0.1892	0.153

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Table 3 shows the overall End to End Delay of the routing during 1, 50, 100,150, 200 rounds atregion.

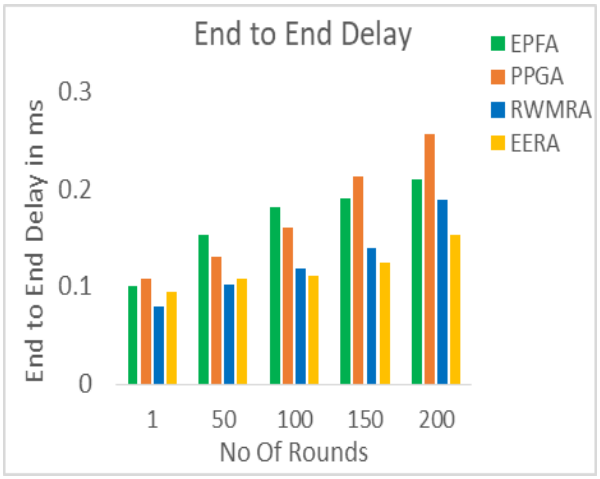

Fig. 2: End to End Delay Vs Time interval at Regions

Fig 2 represents that the EERA algorithm shows reduced End to End time delay of routing than EPFA, PPGA and RWMRA algorithms at 1, 50,100,150,200 rounds.
End to end delay time of the PPGA is increased due to mobility of the sensor node.

Rounds	Packet Loss Ratio			
	EPFA	PPGA	RWMRA	EERA
1	0	0	0	0
50	0.21	0.326	0.308	0.298
100	0.285	0.312	0.294	0.284
150	0.324	0.286	0.2621	0.296
200	0.354	0.322	0.1863	0.26

Table 3 shows the overall Packet Loss Ratio ofthe Clusters during 1 round to 200 Rounds at regions.

Fig. 3 represents RWMRA algorithm shows very less packet loss ratio compared with EPFA, PPGA and EERA Algorithms at 200 rounds.
Packet loss is very high in EPFA because, the sensor node moving out of the cluster region, this algorithm proposed for a cluster region (intra cluster), so the PLRis higher than the other 3 algorithms.

Fig. 3 : Packet Loss ratio Vs Time interval at Regions

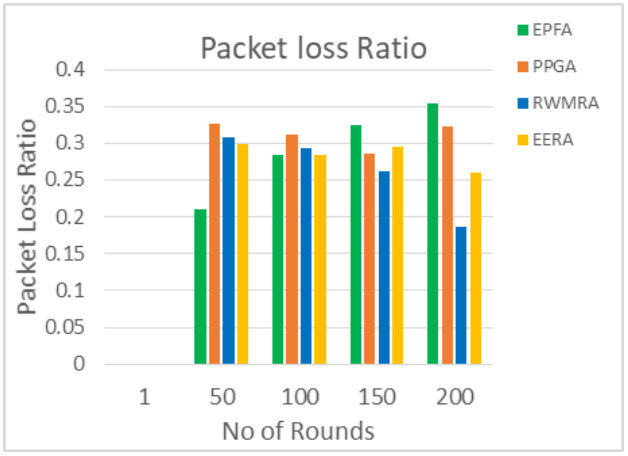

Table 4. Shows the overall Energy consumption of the Clusters during 1 Round to 200 Rounds at regions.

Rounds	Energy Consumption			
	EPFA	PPGA	RWMRA	EERA
1	1.6	1.9575	1.9745	1.9946
50	0.89	1.0638	1.874	1.8988
100	0.68	0.8566	1.7443	1.7981
150	0.51	0.7256	1.6123	1.7002
200	0.43	0.6586	1.477	1.6052

Table 4: Energy consumption Vs Time interval at Regions

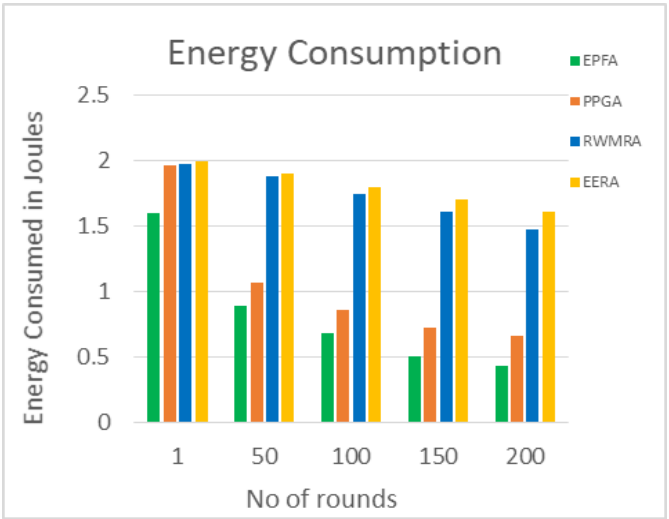

Fig. 4 : Packet Loss ratio Vs Time interval at Regions

Fig. 4 represents that the EPFA Algorithm shows reduced Energy Consumption than in PPGA, RWMRA and EERA Algorithms at 200 Rounds.
The Energy Consumption is high in EPFA, PPGA,

RWMRA and EERA Algorithm at first round.
The Number of Clusters are increased based on the Density of nodes in PPGA, RWMRA and EERA. The Energy Consumption is high in EERA when compared to RWMRA, PPGA and EPFA algorithms.

5. RESEARCH HIGH LIGHT:

Two distinct routing myths propose the cluster-based routing method. Routing based on Intra and inter-cluster factors. To solve the routing inconsistencies in mobile sensor networks, four distinct routing algorithms have been developed.
These algorithms are all used with the Mat Lab tool, and the outcomes are examined.
An enhanced perimeter forwarding algorithm (EPFA) is suggested for intra-cluster routing, and its effectiveness is calculated using the four metrics. Metrics such as end-to-end delay, energy consumption, packet loss ratio, and packet delivery ratio.

Table 5. Overall Performance of theresearch Framework

S.No	Algorithms	Type of Cluster	Performance Evolution
1	EPFA	Intra	PDR, EED, EC
2.	PPGA	Inter	PDR, EED, EC
3	RWMRA	Intra/Inter	PLR, EC
4.	EERA	Intra/Inter	PDR, EED, PLR

6. CONCLUSION:

We have presented a routing algorithms for mobile sensor networks, which is based on the election of a Cluster head and the construction of network with the CH and TH with multiple criteria to obtain the same. On the basis of local information about sensor node, Cluster Head elections are performed in order to restructure the clusters so that message delivery rates could be improved.
The ultimate purpose of those algorithms is to reduce theEnergy Consumption, end to end delay, packet loss and maximize the through put. The results of the existing algorithms are confined to give better result. The performances of the algorithms EPFA, PPGA, RWMRA and EERA discussed in this paper. Here Cluster based routing algorithm reduces reduce the EnergyConsumption, end to end delay, packet loss and maximize the through put.
EERA algorithm is more efficient in terms of reduce the Energy Consumption, end to end delay, packet loss and maximize the through put than EPFA, PPGA and RWMRA.

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