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Relative Node Mass Weighted Clustering Techniques in Manet

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Abstract: Cluster formation forms network nodes to logical groups to minimize signaling overhead needed for network operation on upholding the network connectivity. Recent clustering algorithm of Ad Hoc networks concentrates on weight based method value of each weight and it is evaluated by considering the significance of different factors (indexes). The existing work presented Dynamic Entropy based Combination Weighted (DECW) clustering approach for maintaining stability in both low speed and high speed ad hoc network. For cluster maintenance, Monte Carlo optimization was modeled to prevent frequent cluster-heads (CHs) replacement on mobility. However the method was unable to offer stability in routing and data transmission for high density ad hoc networks. To overcome these drawbacks, the proposed work presents a Relative Node Mass Weighted Clustering for High Density Ad Hoc Network to improve the performance of High Density Ad Hoc Network. Each node's mass is measured with ability of data to be transmitted in the network. The performance measure of the proposed Relative Node Mass Weighted Clustering (RNMWC) is conducted on parameters like Cluster accuracy, Data transmission speed and Routing Delay and Loss.

Key words: Cluster formation · Ad Hoc Network · Optimization

INTRODUCTION

Clustering is the most extensively investigated result for scaling down ad-hoc networks. Maximizing network capacity and minimizing the routing overhead by clustering gives more competence and effectiveness to scalability in relation to node numbers and for high mobility. Formation of cluster includes arranging network nodes into logical groups with the aim of wounding the signal overhead needed for network operation to uphold the network connectivity. The main aim of the grouping process relies on network characteristics and application requirements. The clustering algorithm of Ad Hoc networks spotlight on the weight based method, in which the value of each weight is measured on the significance of various factors. The weighted mean methods are categorized into two categories such as the stable weight method and the dynamic weight one. In the fusion model, the former arranges the decision attribute in the stable weight. It is difficult to adjust the weights once they are set.

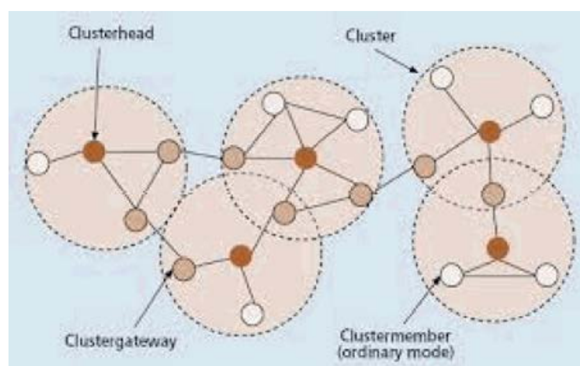

Fig. 1: Cluster Structure in MANET

A weight based distributed clustering algorithm (WCA) are vigorously adapt to itself by the ever varying topology of ad hoc networks. The method possesses the adaptability to assign various weights to takes into account of a mutual result of the ideal degree, transmission power and mobility and battery power of the nodes. Weighted Clustering Algorithm (EWCA) enhances the load balancing and the strength in the MANET.

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The cluster head is chosen powerfully by using the indexes, like high transmission power, transmission range, distance mobility, battery power and energy. Weight based clustering turn into main clustering algorithm in low-speed Ad hoc network due to the cluster stability. Dynamic altering topology in high-speed Ad hoc network reduced cluster stability (network stability) and increased cluster maintenance costs.

Literature Survey: In this paper [1], the author proposed weighted clustering by which each data point is aligned an actual esteemed load. Theoretical study on the control of weighted information on regular clustering algorithms is experimented in every partitioned and hierarchical situations determined by the accurate circumstances by which algorithms respond to weights. It partitions clustering techniques into three wide divisions: weight-responsive, weight-considering and weight-robust.

In this paper [2], the author described about Energy Efficient Cluster Head Selection Scheme Based On FMPDM for MANETs is a novel fuzzy multiple criteria decision making method based on hierarchical fuzzy integral (FAHP) and Fuzzy multiple parameter decision-making (FMPDM). It optimizes the collection of cluster heads to extend a distributed energy-efficient clustering algorithm. In FAHP, Single parameter is used concurrently as important aspects which manipulate the collection of cluster heads while every factor consists of certain sub-criteria.

In this paper [3], the author briefed Clustering & Cluster Head Selection Techniques in Mobile Adhoc Networks are created on-the-fly and appliances must leave and merge the system in its life span. The network is created as a complete mobile and the appliances in the set of connections must be able to sense the occurrence of other appliances and achieve the essential set-up to help communications. MANET is measured as a collection of mobile terminals so the network presentation becomes a difficult task.

In this paper [4], the author analysis the tradeoff of transmission rates and throughputs rate in the Ad Hoc dense networks using uniform-distributed traffic. The optimal rate is carried out with lowest rate. The author proposes a new routing metric that determines the expected capability of path assuming the per-node fairness to improve throughput rate.

In this paper [5], the author elaborated a Framework to increase the lifetime of a Sensor Network by Dynamic Cluster Head Selection and Re-Clustering to insert functionality to presented networks so as to improve the networks life span and also help in improved tracking of strange phenomenon like forest fires. Maximizing the life span is completed by dynamic numerous cluster heads and tracking of strange phenomenon which is completed on the origin of outlier recognition.

In this paper [6], the author demonstrated Particle Swarm Optimization method for constructing energy-aware clusters using optimal collection of cluster heads. The PSO ultimately minimizes the outlay of locating optimal location for the head nodes in a cluster. And also, the PSO-based method is developed within the cluster than base to make it a semi-distributed technique. The selection criterion of the purpose function depends on the residual energy, intra-cluster distance, node degree and head count of the probable cluster heads.

In this work [7], the author provides the Medium Time Metric (MTM) based on possible throughput in multi-rate ad hoc wireless networks. MTM prevents the high range relationships attained using shortest path routing. In addition to, improves throughput rate and further reliable links.

In [8] a review of clustering algorithm is developed, where different weights are provided to different performance factors. By determining mixed weights of nodes, Clustering decisions are performed.

In this paper [9] to enhance the linking and scalability of network using clustering techniques. Hence a new weight based clustering algorithm were introduced using remain energy, signal to noise ratio, mobility and relativity for improved performance in a cluster.

In this paper [10], the author presented the Cluster-head Gateway Switch Routing protocol (CGSR) employs a hierarchical system topology. CGSR systematizes nodes into clusters, with organization by the constituents of every cluster delegated to a particular node called cluster-head. The cluster head collection is completed with the aid of the algorithm for cluster head selection. Energy is the main control on scheming any Wireless Networks basically which directs to inadequate network life span of network.

In this paper [11], introduces the Cluster head (s) selection algorithm derived from an efficient trust model. In order to choose trustworthy stable cluster head(s) that present secure transmission using cooperative nodes. To estimate trusted Cluster head(s) of clusters strength, durability and throughput. In this paper [12] a Node Based Cluster Routing Algorithm (NBCRA) is developed to increase the cluster strength and carry out through selecting better cluster-head. In the algorithm, node monitors and data is utilized to choose cluster-head.

In this paper [13] authors proposed a novel energy responsive load balancing Clustering in Mobile Ad Hoc Networks. The cluster head is overloaded because of movement of nodes in neighborhood. The cluster head of the parent cluster allows the accountability of meeting a new cluster head. The meeting is derived from the weight of the node and its distance from the parent cluster head.

In this paper [14], the author explored an Analysis of the Optimum Node Density for Ad hoc Mobile Networks to evaluate the optimum node density for delivering the enormous data packets. It is proven that it does not quit a global optimum density, but instead to achieve this maximum, the node density must maximize as the rate of node movement increases.

In this paper [15], the author explains Multipath Routing in Mobile Ad Hoc Networks: Issues and Challenges. Multipath routing permits the organization of numerous paths by a single source and single destination node. It is usually presented for increasing the consistency of data broadcast to achieve load balancing. Load balancing is significant in MANETs due to the restricted bandwidth by the nodes.

Selection of Relative Node Mass Weighted Clustering for High Density Ad Hoc Network: Relative Node Mass Weighted Clustering (RNMWC) technique is proposed to develop performance of High Density Ad Hoc Network. Node density variation influence performance of routing and data delivery in ad hoc networks. Each node's mass is calculated with capacity of data to be transferred in the network. Node with higher mass weight is selected as cluster head. Relative mass weight is evaluated in its neighbor Formation of clustering of nodes is done with relative mass of the nodes in the transmission range of ad hoc network. Highly dense node clusters are formed with high capacity data transmission. Multiple cluster heads are generated at different mass range.

$$RE = \left(\frac{DP_s - DP_d}{DP_t} \right) * 100 \quad (1)$$

From (1) RE refers to Routing efficiency is the ratio of different between the data packets sent DPs and the data packets dropped DPd to the data packets sent in Ad Hoc Network.

Routing efficiency is calculated with transmission speed of data packets from Source to its cluster head. Varied density induces the cluster head selection in the respective node mass weighted clusters. Further the CH selection is initiated till CH node's mass is relatively higher compared to other nodes in corresponding cluster.

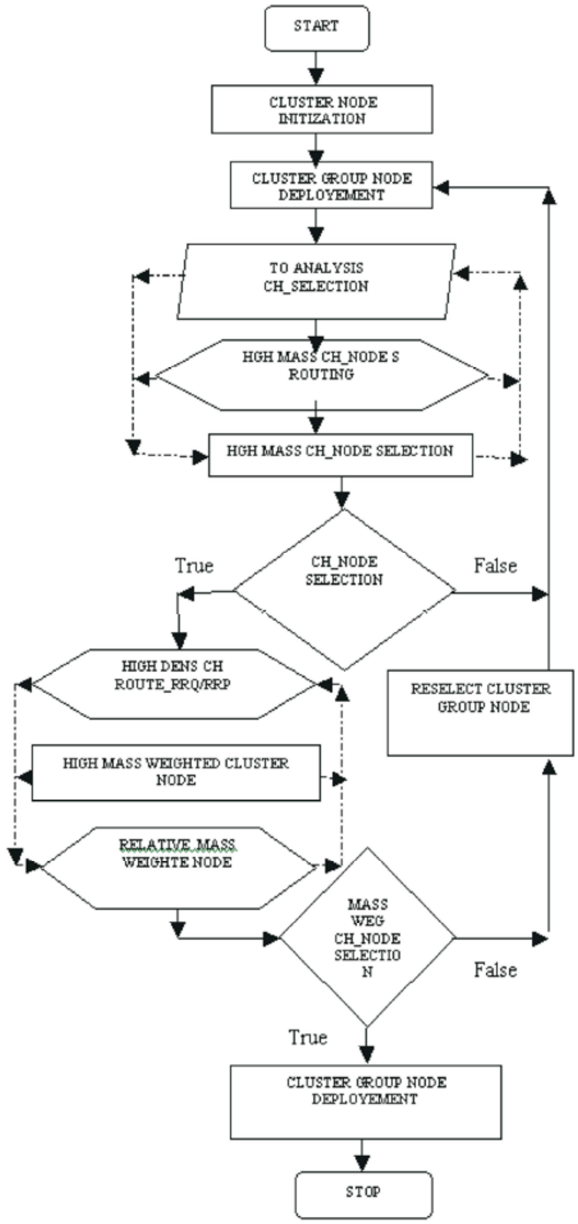

Fig. 3.1: Relative node mass weighted clustering Techinque

It consists of the following modules. They are

- Highly Dense Ad Hoc Network
- Mass Weight Clustering
- Relative Node Mass Assessment
- Mass Weight Cluster Head Selection and Maintenance

The Relative mass cluster algorithm with pseudo-code C is as follows:

```
Evaluate periodically its cluster node routing:
To send regular hello message to the CH's;
If ( No hello message from CH during periodical time)
        Cluster head has been hold up,
        The node deploy must be start again at beginning;
End
If (Received high mass CH info as a result of the reselect start again)
        Fixed the high mass CH in the cluster;
        Received high mass CH-RT update from the old high mass CH-id fo;
        Sending CH-RT-ACK to the old high mass CH-id info;
        Delay for high mass CH-info ();
Else
If high mass CH (hello)==high mass CH(node);
        Update CH node= CH-RT table;
Else if high mass weight (hello form another high mass – CH)> High mass-
weight (last hello message from current high mass- CH node)
Overlook the hello message;
Else
        Continue as a cluster member of the current high mass- CH;
        Send their join request to the high mass=CH is hello;
        Waiting for CH-ACK from the high mass –CH during time periodic;
If (W_ACK is received from the high mass- CH-node)
        Overlook the hello message;
        End
        End
End
If (HM-CH change is received from the CH-node)
        Retrieve the address of new RNM-CH-node is the CH field;
        End
If (RNM-CH information is received from the CH-R Table)
Store the source RNM-CH node address in the CH Field;
End
```

Fig. 3.2: Member node algorithm

This algorithm has begun with selected the High mass weight node as a cluster header, we will forward the hello message to all the neighbors of cluster node in the CH have also been categorized into his high mass clusters. Next, Cluster head Routing table Update CH node selected clustered nodes, which its weight is the smallest and it is reselect group with neighbor nodes of cluster in the same way to reelect the cluster nodes. We choose the high mass weight node as the cluster header of next cluster, moreover if these cluster's header connect each other, then connect two cluster by cluster headers. If the cluster header and cluster header has no connection between, that is, the two clusters cannot communicate with each other after clustered, then we have another work to do. Because it is a connected graph, then the two clusters must have connection between two ordinary nodes, we can choose both nodes as cluster header respectively. And so on, we can have connected graph.

Highly Dense Ad Hoc Network: Node density variation influence performance of routing and data delivery in ad hoc networks. Nature of node transmission power tradeoff in mobile networks determines optimum node density for delivering maximum number of data packets. Node density estimation is done with clusters. Each cluster is appropriate in a sub-region of ad hoc network area. No global optimum density currently exists. To achieve the maximum, node density should increase as the rate of node movement increases. It examines the effects of transmission power on mobile network performance.

Mass Weight Clustering: Mass weight clustering is done to organize nodes with similar mass value (or range of values) in the network. There arrives non-linear prediction of outputs for routing path from inputs of available equal mass weight nodes in the network. Each node's mass is calculated with capacity of data to be transferred in the network.

Formation of clustering of nodes is done with relative mass of the nodes within the transmission range of ad hoc network. Mass weight cluster gives a single output cluster for each routing path for data transmission also extended to multiple clusters which are still associated with the same input cluster. Each mass weight cluster is localized to a Gaussian input region which contains its own trainable local model provides simple and flexible routing path.

Relative Node Mass Assessment: Relative mass weight is evaluated in its neighbor. Each node is assumed to have uniform transmission range and homogeneous network. Nodes within transmission range of a particular node are identified as 1-hop neighbors of that node. Each node identifies its 1-hop neighbors by transmitting Hello messages. The nodes are allowed to move randomly in different directions with varying velocity in the range. Track the changes in node positions nodes send and receive Hello messages periodically at a predefined broadcast interval BI.

Mass Weight Cluster Head Selection and Maintenance: Node with higher mass weight is selected as cluster head. Highly dense node clusters are formed with high capacity data transmission. Multiple cluster heads are generated at different mass range. Varied density induces the cluster head (CH) selection in the respective node mass weighted clusters. Further the CH selection is initiated till CH node's mass is relatively higher compared to other nodes in corresponding cluster.

Performance Metrics: In this section evaluate the performance of Relative Node Mass Weighted Clustering for High Density Ad Hoc Network through NS2 environment. The simulation results was performed on NS2 and compared with the existing Dynamic Entropy Based Combination Weighted Clustering. One of the major contributions of this work is to improve the efficiency of routing and data transmission in high density ad hoc networks. The performance metrics of the parameters is Highly Dense Ad Hoc Network, Mass Weight Clustering, Relative Node Mass Assessment, Mass Weight Cluster Head Selection and maintenance.

The Performance Metrics Are:

- Cluster Accuracy
- Data Transmission speed
- Routing Delay and Loss

Table 4.1: NS2 simulation parameter

PARAMETER	VALUES
Protocols	AODV
Network Range	1025*960
Network Simulator	NS 2.34
Mobility Speed	2ms
Pause Time	4.85s
No of Mobile Nodes	10-100
Packets	7,14,21,28,35
Simulation Time	50ms

Cluster Accuracy: Accuracy level for cluster accuracy refers to the proportion of the total number of segmentations that were performed correct. The Accuracy level for cluster accuracy is mathematically formulated as given below

$$A = \frac{segmentations\ \ that\ were\ performed\ correct}{s} * 100$$

Higher the accuracy level more efficient the method is said to be.

Figure 4.1 demonstrates the classification accuracy. X axis represents the Node Density whereas Y axis denotes the cluster accuracy (%) using both the Dynamic Entropy based Combination Weighted (DECW) technique and the proposed Relative Node Mass Weighted Clustering (RNMWC) technique.

Table 4.2: Node Density Vs Cluster Accuracy (%)

	Cluster Accuracy (%)	
Node Density	Existing DECW	Proposed RNMWC
20	69	71
40	72	75
60	74	77
80	78	81
100	80	85

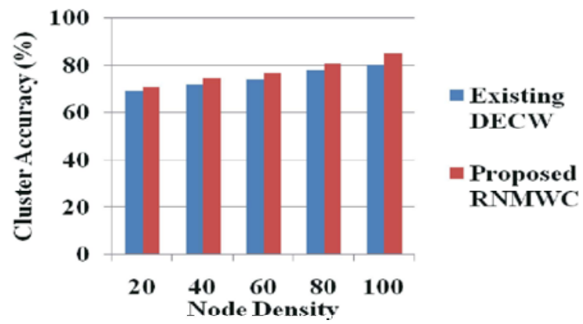

Fig. 4.1: Node Density Vs Cluster Accuracy (%)

When the node density is increased, classification accuracy gets increases consequently. Classification accuracy is illustrated using the existing DECW technique and proposed RNMWC technique. Figure 4.1.shows the better performance of proposed RNMWC method than existing DECW and proposed RNMWC. Relative Node Mass Weighted Clustering method achieves 3 to 5% high performance when compared with existing system

Data Transmission Rate: The data rate can be traveled across an each node to send from one node to another. The Data Transmission rate is ratio of difference between numbers of packets received at destination to the total number of packets and measured in terms of percentage (%).

$$DT\ rate = \frac{No\ of\ \ packets\ received\ at\ the\ destination}{Total\ Number\ of\ \ packet} * 100$$

Table 4.3: Node Density Vs Data Transmission speed (rps)

	Data Transmission speed (rps)	
Node Density	Existing DECW	Proposed RNMWC
20	18	20
40	21	23
60	25	27
80	28	31
100	30	35

Figure 4.2 demonstrates the Data Transmission speed. X axis represents the Node Density whereas Y axis denotes the Data Transmission speed (rps) using both the Dynamic Entropy based Combination Weighted (DECW) technique and the proposed Relative Node Mass Weighted Clustering (RNMWC) technique. When the node density is increased, Data Transmission speed gets increases consequently. Data Transmission speed is illustrated using the existing DECW technique and proposed RNMWC technique.

Figure 4.2.shows the better performance of proposed RNMWC method than existing DECW and proposed RNMWC. Relative Node Mass Weighted Clustering method achieves 5 to12% high performances when compared with existing system.

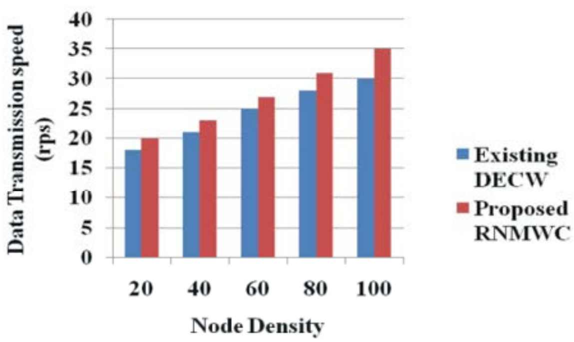

Fig. 4.2: Node Density Vs Data Transmission speed (rps)

Routing Delay and Loss: When packets appear in a router, they must be progressed and sent. A router can simply process one packet at a time. If packets appear earlier than the router can process them, then the router arranges them into the queue until it can obtain about to transmitting them. Delay always ranges from packet to packet and therefore averages and statistics are typically generated when calculating and determining queuing delay.

$$D_R = \left(\frac{ST - ET}{N} \right)$$

where DR is denoted as routing delay and ST refers to the starting time to the packets send and ET indicates the ending time to the packets received and N is number of packets.

The routing loss is difference between the total packets sent to the packets not received (i.e. packets dropped).

$$RL = Ps - Pd \quad (2)$$

From (2) RL is a Routing Loss is and Ps refers to the packet sends and Pd is refers to the data packets not received (i.e. rate of packet drop). It is measured in terms of packets per second (p/s).

Table 4.4: Node Density Vs Routing Delay and Loss (%)

	Routing Delay and Loss (%)	
Node Density	Existing DECW	Proposed RNMWC
20	22	25
40	25	27
60	28	30
80	31	34
100	35	38

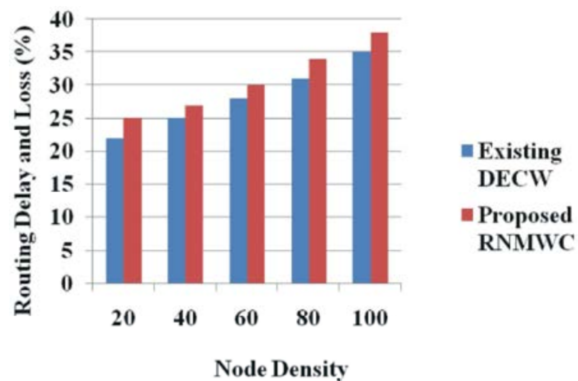

Fig. 4.3: Node Density Vs Routing Delay and Loss (%)

Figure 4.3 demonstrates the Routing Delay and Loss. X axis represents the Node Density whereas Y axis denotes the Routing Delay and Loss (%) using both the Dynamic Entropy based Combination Weighted (DECW) technique and the proposed Relative Node Mass Weighted Clustering (RNMWC) technique.

When the node density is increased, Routing Delay and Loss gets increases consequently. Routing Delay and Loss is illustrated using the existing DECW technique and proposed RNMWC technique. Figure 4.3.shows the better performance of proposed RNMWC method than existing DECW and proposed RNMWC. Relative Node Mass Weighted Clustering method achieves 5 to 10% high performances when compared with existing system.

CONCLUSION

A Dynamic Entropy based Combination Weighted (DECW) clustering approach for maintaining stability in both low speed and high speed ad hoc network.It also evaluates the information entropy deviation of indexes and maintains arrival of dynamic entropy weight of each node. Optimization of multi-node dynamic entropy weights is introduced to reduce weight vector deviation and nullify frequent cluster-heads (CHs) replacement. Recent clustering algorithm of Ad Hoc networks focus on weight based method value of each weight is calculated based on the importance of different factors (indexes). Methods of weighted mean are divided into two categories i.e., stable weight and sets each decision attribute with stable weight in the fusion model dynamic weight. Finally, Weight based clustering algorithm is introduced in low-speed Ad hoc network as it possess high cluster stability.

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