A

Dissertation

On

Enhanced Cluster Head Selection Strategy For Efficient Routing in Adhoc Network

Submitted in partial Fulfillment of the requirement

For the award of the Degree of

Master of Technology

In

Computer Science & Engineering

Submitted By

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DELHI TECHNOLOGICAL UNIVERSITY

2011-2013

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CERTIFICATE

This is to certify that the dissertation titled "**Enhanced Cluster Head Selection Strategy For Efficient Routing in Adhoc Network**" is a bonafide record of work done at **Delhi Technological University** by **Sourabh Mehrotra, Roll No. 2K11/CSE/16** for partial fulfilment of the requirements for the degree of Master of Technology in Computer Science & Engineering. This project was carried out under my supervision and has not been submitted elsewhere, either in part or full, for the award of any other degree or diploma to the best of my knowledge and belief.

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ACKNOWLEDGEMENT

I would like to express my deepest gratitude to all the people who have supported and encouraged me during the course of this project without which, this work could not have been accomplished.

First of all, I am very grateful to my project supervisor Mr.Vinod Kumar for providing the opportunity of carrying out this project under his guidance. I am deeply indebted to him for the support, advice and encouragement he provided without which the project could not have been a success.

I am also thankful to my Mom and Dad for being there for me at all times. I am grateful for the support of my closest friends Puneet, and Milind for helping me think in the right direction. Last but not the least; I am grateful to Delhi Technological University for providing the right resources and environment for this work to be carried out.

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ABSTRACT

Ad-hoc networking is a model in wireless device interactions, which represent that users wanting to communicate with each other form a temporary network, without any form of centralized administration. Each node participating in the network acts both as host and a router therefore, it is capable of forwarding packets for other nodes. For this purpose a routing protocol is needed i.e. it should try to minimize control traffic, such as periodic update messages.

Clustering in Mobile Ad Hoc Networks (MANETs) has many advantages compared to the traditional networks. But the highly dynamic and unstable nature of MANETs makes it difficult for the cluster based routing protocols to divide a mobile network into clusters and determination of cluster heads for each cluster. As we know cluster head play an important role in MANETs because selection of stable cluster head makes routing algorithms more efficient. Although, there are lots of cluster head selection algorithms available, here we introduce a new strategy. The proposed scheme for improved cluster head selection utilizes mobility, signal to noise ratio (SNR) and battery power of a node. A weighted function based on all three characteristics is used to calculate the stable cluster head.

A comparative analysis of the proposed strategy is compared with a novel solution given by Chopra et al. The result clearly show that we proposed scheme provide improved performance and more stable cluster head.

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1. INTRODUCTION

An ad hoc network as an autonomous system of mobile hosts (also serving as routers) connected by wireless links, nodes are mobile, topology dynamically change. Since the nodes are mobile, the network topology may change rapidly and unpredictably over time. The network is decentralized; where all network activity including discovering the topology and delivering messages must be executed by the nodes themselves.

As for the mode of operation, ad hoc networks are basically peer-to-peer multi-hop mobile wireless networks where information packets are transmitted in a store-and-forward manner from a source to an arbitrary destination, via intermediate nodes as shown in Figure 1.1[14]:

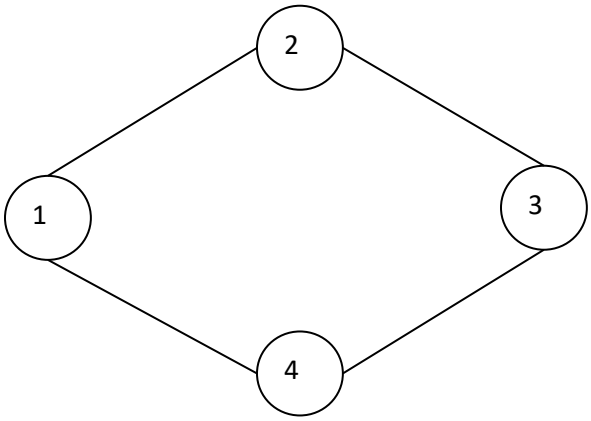


Figure 1.1 Data Transmission in MANET

As shown in the fig.i.1 If node 1 want to send some information to node 3 .it will used either node 2 or node 4 as a intermediate node suppose node 1 sent information to node 4 then node 4 will forward that information to node 3.

1.1 MANET VULNERABILITIES:

Vulnerability is a weakness in security system. A particular system may be vulnerable to unauthorized data manipulation because the system does not verify a user's identity before allowing data access. MANET is more vulnerable than wired network. Some of the vulnerabilities are as follows [14]:

1.1.1 Lack of centralized management:

As we know MANET is an infra-structure less network and topology if the network is dynamically change so there is no centralized unit for monitoring the network. it makes difficult to identify the fault /attack in the network.

1.1.2 Resource availability:

Resource availability is a major issue in MANET. Providing secure communication in such changing environment as well as protection against specific threats and attacks, leads to development of various security schemes and architectures. Collaborative ad-hoc environments also allow implementation of self-organized security mechanism**.**

1.1.3 Scalability:

As we know in ad-hoc network nodes are mobile, they move from one place to another place all the time. So scalability is a major issue concerning security. Security mechanism should be capable of handling a large network as well as small ones.

1.1.4 Cooperativeness:

Most of the routing algorithm assume that nodes are Cooperative and non-malicious. Attacker can use this point and makes thread in the network by disobeying the protocol specifications.

1.1.5 Dynamic topology:

As we know in MANET nodes moves from one place to another place all the times. This reduces the trusted relationship among the node. The trust may also be disturbed if

some nodes are detected as compromised. This dynamic behavior could be better protected with distributed and adaptive security mechanisms.

1.1.6 Limited power supply:

In MANET nodes are mobile having limited power supply .and as we know in ad-hoc network intermediate nodes use for data /information transmission. A node in mobile ad-hoc network may behave in a selfish manner when it is finding that there is only limited power supply.

1.1.7 Bandwidth constraint:

In MANET low capacity links exists as compared to wireless network which are more susceptible to external noise, interference and signal attenuation effects.

1.1.8 Adversary behavior inside the Network:

The mobile nodes within the MANET can freely join and leave the network. The nodes within network may also behave maliciously. This is hard to detect that the behavior of the node is malicious. Thus this attack is more dangerous than the external attack. These nodes are called compromised nodes.

1.1.9 No predefined Boundary for a node:

In mobile ad-hoc networks we cannot precisely define a physical boundary of the network. The nodes work in a nomadic environment where they are allowed to join and leave the wireless network. As soon as an adversary comes in the radio range of a node it will be able to communicate with that node. The attacks include Eavesdropping impersonation; tempering, replay and Denial of Service (DoS) attack [14].

1.2 SECURITY GOALS IN MOBILE ADHOC NETWORK:

In ad-hoc network routing, packet forwarding, route discovery are performed by node themselves in a self-organized manner. For these reasons, securing a mobile adhoc network is very challenging. The goals to evaluate if mobile adhoc network is secure or not are as follows:

1.2.1 Availability:

Availability means the resource are accessible to authorized parties at appropriate times. Availability applies both to data and to services. It ensures the survivability of network service despite denial of service attack.

1.2.2 Confidentiality:

Confidentiality means resources can be accessed only by authorized node .To maintain confidentiality of some confidential information; we need to keep them secret from all entities that do not have privilege to access them. Confidentiality is sometimes called secrecy or privacy.

1.2.3 Integrity:

Integrity means security from inside threads. As we know in MANET its really difficult to identify the fault node .So due to this cause maintain Integrity is important ad-hoc network.

1.2.4 Authentication:

Authentication ensures the node to identify the peer node it is communicating with. Authentication guarantees that the participants in communication are authenticated and not impersonators.

1.2.5 Non repudiation:

Non repudiation ensures that sender and receiver of a message cannot deny that they have ever sent or received such a message .This is helpful when we need to find out a either a node is compromised or not .

1.2.6 Anonymity:

Anonymity means all the information that is used to identify the owner and current user of the node must be kept secret.

1.2.6 Authorization:

Authorization means how much privilege a node has in the network. For example only network administrator can perform network management task in mobile ad-hoc network.

1.3 TYPE BROADCASTING APPROACHES IN MANET:

There are four type of broadcasting approaches used in MANET [14] that are as follows:

a) **Unicasting:** when source send message to only one destination.

b) **Multicasting:** when source send message to set of destinations.

c) **Broadcasting:** when source send message to all the node present in the network

d) **Geocasting:** when source send message to the entire node present inside a geographical region.

1.4 ATTACKS IN MANET:

One of the challenging issues in MANET to provide security. first step to towards developing good security solution in ad-hoc network is to identify the number of attack that can be apply on the it[18].

There are two type of attack in MANET

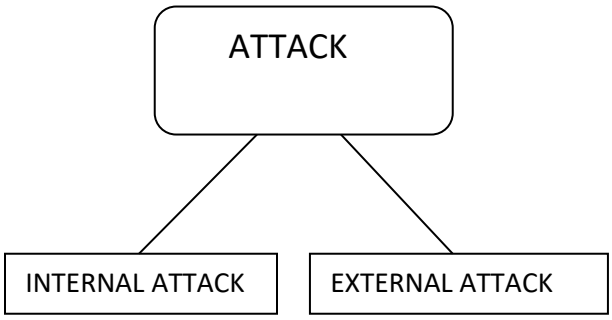


FIG 1.4.1 ATTACKS IN MANET

1.4.1 External Attack:

External attack is done by external node (external node are those node that do not belong to the network).its cause are unavailability and service and false routing information.

1.4.2 Internal Attack:

Internal attack is done by internal node (internal nodes are those node that belong to the network) or compromised node .these compromised node get unauthorized access and behave like genuine node.

a) Denial of Service attack:

Main aim of this attack is to prevent the availability of the node or whole network. Attacker generally use uses radio signal jamming and the battery exhaustion.

b) Impersonation:

If there is no effective authentication mechanism implemented in the network. Fault node (compromised) node can act as genuine node and can monitor the network traffic and can also send fake routing packet and gain access to some confidential information.

c) Eavesdropping:

If there is fault node is present in the network it can observes the confidential information. And can use this information later like location of the node , private key password etc.

d) Routing Attacks:

This type of attack can be done by two way by The malicious /compromised node .one is compromised node can attack on routing protocol and another compromised node can attack on packet forwarding and delivery service.

e) Black hole Attack:

In this attack malicious node broad cast zero metric for all destination causing all nodes around it to be route packet toward it [4,9].A malicious node sends fake routing information and calming that he has optimum route and cause all the good nodes will send their information through this node malicious node nodes drop all the information that receive instead for forwarding those information.

f) Wormhole Attack:

In this attack malicious node receives packet at one point in the network “tunnels” then to another point in the network. and then replays them in to the network from that point. This tunneling of packet disrupted the routing called warm whole attack.

g) Replay Attack:

In this type of attack attacker repeatedly retransmitted the valid data in the network to increase the network traffic. this type of attack usually targets the freshness the routes.

h) Jamming:

In this type of attack attacker initially keep monitoring the wireless medium in order to identified the frequency at with data is transmitted to the destination and then it send signal on that frequency so that error free receptor is hindered.

i) Man-in- the-middle attack:

An attacker sites between the sender and receiver and sniffs any information being sent between two nodes. In some cases, attacker may impersonate the sender to communicate with receiver or impersonate the receiver to reply to the sender.

j) Gray-hole attack:

In this attack firstly attacker advertises that it has valid route to destination then it drops intercepted packets with a certain probability. Some time it is called that routing misbehavior attack.

1.5 MANET APPLICATIONS:

As we know we can apply ad-hoc anywhere where there is little or no communication infrastructure or the existing infrastructure is in convenient or expensive to use.ad-hoc network allow device to easily connect with network and easily to remove from network. as we know now days mobile device is going to increasing day by day so the ad-hoc networking is gaining importance with the increasing number of widespread applications.

Typical applications include [13, 9]:

1. **Military Battlefield:**

   Military equipment now routinely contains some sort of computer equipment. Ad-hoc networking would allow the military to take advantage of commonplace network technology to maintain an information network between the soldiers, vehicles, and military information headquarters. The basic techniques of ad hoc network came from this field.

2. **Commercial Sector:**

   If we talk about emergency/rescue operation for disaster relief example flood, earthquake .on that place there is no existing infrastructure so we can use MANET in this area .

3. **Local Level:**

   Ad-hoc networks can autonomously link an instant and temporary multimedia network using notebook computers or palmtop computers to spread and share information among participants at e.g. conference or classroom. Another appropriate local level application might be in home networks where

devices can communicate directly to exchange information. Similarly in other civilian environments like taxicab, sports stadium, boat and small aircraft, mobile ad hoc communications will have many applications.

4. **Personal Area Network (PAN):**

   Short-range MANET can simplify the intercommunication between various mobile devices (such as a PDA, a laptop, and a cellular phone). Tedious wired cables are replaced with wireless connections. Such an ad hoc network can also extend the access to the Internet or other networks by mechanisms e.g. Wireless LAN (WLAN), GPRS, and UMTS. The PAN is potentially a promising application field of MANET in the future pervasive computing context.

1.6 MANET CHALLENGES:

Regardless of the attractive applications, the features of MANE introduce several challenges that must be studied carefully before a wide commercial deployment can be expected. These include [4,9]:

1.6.1 Routing:

Since in MANET topology of the network is dynamically changes with respect to time that means nodes are free to move from one place to another place. So it is very difficult to implement efficient routing technique in dynamic environment.

1.6.2 Security and Reliability:

Ad-hoc network has its particular security problems due to e.g. nasty neighbor relaying packets. The feature of distributed operation requires different schemes of authentication and key management. Further, wireless link characteristics introduce also reliability problems, because of the limited wireless transmission range, the broadcast nature of the wireless medium (e.g. Hidden terminal problem), mobility induced packet losses, and data transmission errors.

1.6.3 Quality of Service (QoS):

Providing different quality of service levels in a constantly changing environment will be a challenge. The inherent stochastic feature of communications quality in a MANET makes it difficult to offer fixed guarantees on the services offered to a device. An adaptive QoS must be implemented over the traditional resource reservation to support the multimedia services.

1.6.4 Inter-networking:

In addition to the communication within an adhoc network, inter-networking between MANET and fixed networks (mainly IP based) is often expected in many cases. The coexistence of routing protocols in such a mobile device is a challenge for the harmonious mobility management.

1.6.5 Power Consumption:

As we know in MANET most of node is light weight mobile terminal. so energy is one of the important constraint so it is important to implement energy efficient routing technique.

2. ROUTING PROTCOL

Now day routing in MANET is one of the most famous research area .because of issue like high power consumption, mobility of nodes, dynamic topology generally, current routing protocols for MANET can be categorized as:

2.1 PROACTIVE (TABLE-DRIVEN):

In table driven or proactive routing protocol each node contain one or more routing table to store routing information and response to change in network topology by broad casting and propagating. some existing routing protocol are: DSDV (Destination Sequenced Distance-Vector, 1994), WRP (Wireless Routing Protocol, 1996), CGSR (Cluster head Gateway Switch Routing, 1997), GSR (Global State Routing, 1998), FSR (Fisheye State Routing, 1999), HSR (Hierarchical State Routing, 1999), ZHLS(Zone based Hierarchical Link State,1999),STAR (Source Tree Adaptive Routing, 2000) [2,6].

2.2 REACTIVE (SOURCE-INITIATED ON-DEMAND DRIVEN):

These protocols try to eliminate the conventional routing tables and consequently reduce the need for updating these tables to track changes in the network topology. in

reactive routing when source required destination , use route discovery method to get route .Some of the existing re-active routing protocols are [12,14]. DSR(Dynamic Source Routing, 1996), ABR (Associativity Based Routing, 1996), TORA (Temporally-Ordered Routing Algorithm,1997), SSR (Signal Stability Routing, 1997), PAR (Power Aware Routing,1998), LAR (Location Aided Routing, 1998), CBR (Cluster Based Routing, 1999), AODV (ad hoc On Demand Distance Vector Routing, 1999).

2.3 HYBRID PROTOCOLS:

This approach use both pro-active and re-active approach to routing the packets. In this approach node is divided in to zone. Inside a zone node use proactive routing. Two zone use reactive routing to packet transfer[2, 13].

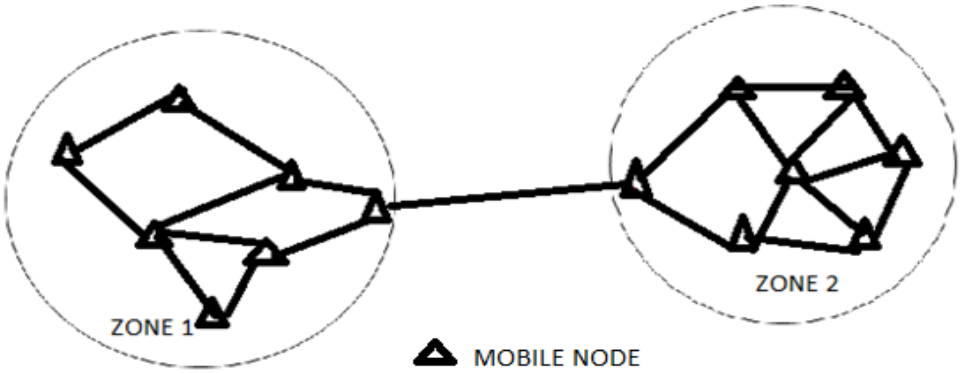


FIG 2.4 Data Transfer Between Zones (cluster)

These protocols can provide a better trade-off between communication overhead and delay, but this trade-off is subjected to the size of a zone and the dynamics of a zone. Thus, the hybrid approach is an appropriate candidate for routing in a large network.

3. CLUSTERING IN MANET

Ad-hoc is a infrastructure less network in which node can move from one place to another place, topology of the network dynamically change. in a large network, if we talk about flat routing, produce very large amount data/information than can saturate the network in addition, as we know in ad-hoc network node are heterogeneous so they may have highly variable amount of resources, and this produce a hierarchy in their roles inside the network. Node having high computation power. Powerful batteries and less mobility are suitable for ad-hoc network [20].

Another solution of heterogeneous node is cluster based routing. in cluster based routing limited amount of routing information propagate inside the network. The idea behind clustering is to group the network nodes into a number of overlapping clusters. in cluster based routing path is recorded between the cluster instead of node. This increase the routing time, thus decrease the amount of routing control overhead. Inside the cluster the node works as a **CLUSTERHEAD (CH).** CH is responsible for routing the information inside the network. All the ordinary node have direct access to the CH. there is another node in cluster know as gateway. Gateway can hear one or more cluster head.

Normal/Ordinary node wants to transfer their information. if will send his packet to CH .if destination node is present inside the cluster then CH directly send this packet to destination node .otherwise CH sent this packet to gateway node .and gate way send this packet to gateway of another cluster and so on.

3.1CLUSTERING ALGORITHM IN MANET:

There are five type of clustering algorithm: [14, 10, 3, 1, and 12]

1. Identifier-based clustering
2. Connectivity-based clustering
3. Mobility-aware clustering
4. Low cost of maintenance clustering
5. Power-aware clustering

3.1.1 Identifier-based clustering:

In this approach a unique ID is assign to each node. Each node knows about its neighbor's node id and cluster head (CH) id. There are some rule, use to select a cluster head. [12]. Node having minimum id choose as CH .thus id of the neighbor of the CH must be greater than the CH id. A node that can hear two or more CH is called as gateway node.

Each node assigns an id (unique).periodically each node broadcast list of node with their ids including itself. If the node has lower id all the node within a range will work as CH. A node hear id greater than itself work as cluster head.

3.1.2 Highest connectivity clustering algorithm:

In this scheme node with highest number on neighbor will be work as cluster head. In this scheme each node broad cast number called as id this id show that how many number of neighbor node has. Node having highest id will be work as cluster head. This type of cluster head algorithm has a low rate of clusthead change but the Throughput is low. The drawback of this algorithm is that this approach does not have any restriction on the upper bound on the number of nodes in a cluster.

3.1.3 Mobility-aware clustering:

In this approach each node measure it's receive signal strength. a node can calculate its distance from its physically close neighbor ,signal show closeness of the node. This scheme is based on five important term: the estimate distance between nodes, the relative mobility between nodes, the variation of estimated distance over time, the local stability, and the estimated mean

distance. . Relative mobility can be calculated by difference of the estimated distance of one node with respect to another, at two successive time moments. This parameter indicates if two nodes move away from each other or if they become closer. Here we are calculating variation of estimated distances between two nodes is computed instead of calculating physical distance between two nodes, because physical distance is not a measure of closeness. Suppose a node having lower energy it will transmit the packet with low signal will be treating as a distance node form the physically closer node. We can calculate local stability by variation of estimated distance and the relative mobility between nodes. Thus the node have less local mobility will be treat as CH.

3.1.4 Low cost of maintenance clustering:

As we know most of the clustering protocol use clustering periodically and re-cluster the node to satisfied the cluster head selection rule. in LLC(lowest cluster change scheme) there are two steps.

1. Cluster formation: ID based clustering is used for cluster formation. The node having least id will be work as cluster head.
2. Cluster maintenance**:** CH is responsible for cluster maintenance.

Re-clustering is done in two cases:

a) When two clusters come into each other range, one quit from the cluster head position.
b) When mobile node moved out the range of the cluster and formed new cluster.

3.1.5 Power-aware clustering:

In PWC (Power-aware clustering) node have higher power in term of battery, work as cluster head. The node having higher can work as a cluster head for long time. In this scheme each node broadcast its power the node having highest power work as cluster head.

4. RELATED WORK

Mobile ad-hoc network is infrastructure less network. In which topology of the network dynamically change, nodes are mobile. Routing in MANET must be time efficient and resource shaving .that's why efficient clustering and routing in MANET has been a topic of research in the past few days [7].

Clustering comes under the hierarchical routing technique. most of the clustering method based on cluster head(CH)[17,14,5].In the most of the proposed method, much thought has not been given for the selection of the cluster head in order to get stable network we need to select stable cluster head. In [17] CH is selected on the basic of node identifier and thus CH may not be stable. In [11] CH selection is done by concept of associativity was used to get long live path in routing .associativity provide temporal stability not long time stability. In this proposed approach cluster head selection is done by *voting algorithm.* Using this algorithm node in the network interact with each other and select cluster head. In novel approach only used weighted functions that calculate the optimal position of the cluster head. They use signal to noise ration to calculate the optimal position of the cluster head [7].

5. PROPOSED APPROACH

5.1 SYSTEM MODEL:

Here we consider a modeling which all nodes have prior information about their location or position. If we append GPS system with each node then node can get their position. we will describe our model in two phase.

5.1.1 Cluster formation:

In our approach cluster formation is done by basis. But cluster should be form in such way that the resulting network must be cluster connected. A network is cluster connected if it satisfied following condition.

- The union of the cluster must cover the entire node.
- There must be a path from each node to every other node through other cluster

There are two type of routing possible in cluster .routing inside the cluster and routing between the clusters. Here we assumed that each node inside the cluster can directly communicate with each other. Each node has its unique id this is called node_id. Every node contain list of nods in the network and there location in its cluster.

As soon as node becomes active .it tries to join a cluster and follow the certain rule

- It broadcast hello packet and wait for reply for a fix amount of time, called as time out.

- If this node in the range of any cluster head (CH) and CH listen his hello packet, it replay to the request.
- If node does not get any reply before timeout. It will assume that there is no cluster present and will become the cluster head.
- If it received a reply, it will send an ACK to CH. If it receives more than one reply then it will chose, cluster head have high signal strength and send him an acknowledge (ACK).
- After getting the reply CH inform the entire network about the newly node means simply broad cast its location to the entire node in cluster.

Using this approach we get the basis cluster network. Note that above procedure does not give a optimal position of the cluster head. We will use an algorithm by which we will try to get optimal position of the cluster head.

5.2 CLUSTER MAINTENANCE:

Once we get a basic cluster, the next job is to optimally evolve the cluster head .let sees how we will get the stable cluster head and to do this algorithm is described below [7].

- Each node calculates the optimal position of the cluster head. By equation 1 and equation 2this position is the weighted location with weight various node inversely proportional to the SNR value of hello packet transmitted by corresponding packet, inversely proportional to the mobility of the node and proportional to the battery power of the corresponding node[7].

$$Xi\ optimal = \frac{\sum_{k \in cluster} x_k w_{j,k}}{\sum_{k \in cluster} w_{j,k}} \qquad (1)$$

$$Yi\ optimal = \frac{\sum_{k \in cluster} Y_k w_{j,k}}{\sum_{k \in cluster} w_{j,k}} \qquad (2)$$

Here X_i and y_i is optimal position of the cluster head as describe by J^{th}node, $W_{j,k}$ is the weighted function $W_{j.k}$ is:

$$W_{j,k=} \frac{A}{SNR_{j,k}} + B * battery_k + \frac{C}{mobility_k} \quad (3)$$

Here A**, B, C** are the constant let assume A=1 unit B=1 unit, C=1 unit

In our approach we consider three factor of a node , SNR ration of the node, battery power of the node, mobility of the node we will select our cluster on the basic of these three factor.

- SNR: For a good cluster head SNR must be good. So that it can transmit the data /packet to the entire node inside the cluster.
- BATTERY: for a good cluster node must have good battery power so that it can work as CH for a long period of time.
- MOBILITY: for a good cluster node must h less mobility so that I can serve long time as CH. If a node has high mobility may be moved soon and we have to rebuild cluster again.

- Each cluster member done this process to find optimal position of the cluster head.
- CH receives votes from all the cluster nodes and evaluates their means to get optimal position of the cluster head thus the optimal position of the cluster head will be.

$$X^i_{optimal} = \frac{\sum k \in cluster X^i_{optimal,j}}{Ni} \quad (4)$$

$$Y^i_{optimal} = \frac{\sum k \in cluster Y^i_{optimal,j}}{Ni} \quad (5)$$

Where Ni = number of node in the cluster

- If new location is in the current CHS proximity .it continue to do the job of CH .it inform this to the member by broadcasting the result packet
- If optimal location is far away from the CH it will select the node which is nears the location.

- If two node having same distance from the optimal point then CH will select the node having higher battery power and low mobility.
- After selecting the node CH will inform the node about his new role as cluster head and wait for acknowledgment.
- Newly selected CH sends an ACK packet to the old CH and then broadcast to the cluster that it has taken over the job of CH

  This algorithm is timely executer and gives a stable cluster head to establish a stable network [7].

6. EXPERIMENTAL METHODOLOGIES

We proposed an algorithm in which we calculate some factor of the node. on the basis of these factor we calculate the optimal position of the cluster head.

i. Mobility of node
ii. Signal to noise ratio
iii. Battery drain
iv. Weighted function
v. X_optimal
vi. Y_optimal
vii. X_ final
viii. Y_final
ix. Total covered distance by CH

6.1 MOBILITY OF A NODE:

As we know in adhoc network node are mobile and the can move from one place to another place. A node with high velocity, have very high probability to leave cluster soon .A node having low velocity may have less chance to leave cluster. We cannot choose a node having high velocity as cluster head.

We use uniformly distributed function to generate velocity of a node .we assume that each node have a distinct constant velocity. The node have high velocity will move fast from its original position.

6.2 SNR:

Signal to noise ration compare level of desire signal to the level of noise signal. It is defined as the ratio of signal power to the noise power, in adhoc network. A ratio higher than 1:1 (greater than 0 dB) indicates more signal than noise. While SNR is commonly quoted for electrical signals, it can be applied to any form of signal [23].

The power received per unit area from an isotropic antenna is calculated from the following equation [24]:

$$P_r = {P_t}/{4 \prod D^2} \qquad [6]$$

6.3 BATTERY REMAINS:

As we know each node in ad-hoc network work on battery. For each data transfer they must have loss some of battery power. On the basis of battery power a node work in three modes [16].

6.3.1 Transmission Mode:

A node is called in transmission node when its send data packet to other node . these node required some energy to transmit data to another node this energy called transmission energy or energy drain, after each transmission energy of node reduces[24,25].

6.3.2 Reception Mode:

In reception mode node gets data from other node. In this node energy of the node also get reduces for processing the data [8, 22].

6.3.3 Idle Mode:

In this mode, node is neither transmitting nor receiving any data packets [22, 15]. But this mode consumes power because the nodes have to listen to the wireless medium continuously in order to detect a packet that it should receive, so that the node can then switch into receive mode from idle mode. In our approach we use a factor battery drain. Battery drain means how much battery power of a node will be loss in idle mode or reception mode or transmission mode. We assumed that Battery drain of the node in all three modes will be same but for a distinct node will be distinct.

6.3.4 Generation of the Battery drain:

We use a uniformly distributed random function that generate the uniformly distributed value for each node as battery drain. After generating the battery drain we can easily calculate the value of remaining battery of a node.

$$node^{i}_{battery_{remain}} = \left(node^{i}_{batteyremain} \right) - \left(node^{i}_{battery_{remainl}} * node_{i\ battry\ darin}/100 \right) \quad \textbf{[7]}$$

6.4WEIGHTED FUNCTION:

Weighted function is use to calculate between two nodes to get a optimal position of the cluster head. Gourav chopra,Satyam Srivastavaand Abhay Karandikar proposed an Approach" *A Novel Strategy For Efficient Routing In Ad-HOC Network".* in this approach that used weighted function as given below[7],

$$W_{j,k} = \frac{1}{SNR_{j,k}} \quad [8]$$

They just use signal to noise ratio(SNR) in the cluster head calculation .on the basis of this weighted function they calculated optimal position of the cluster head. But in Ad-hoc network mobility of a node and battery power also play an important role .if a node has high mobility, may move soon from cluster boundary. If a node having low battery may behave like as selfish node. So we can not choose this type of node as a cluster head. So we modified weight function in term of mobility and battery power of a node. Modified weighted given below.

$$W_{j,k=} \frac{A}{SNR_{j,k}} + B * battery_k + \frac{C}{mobility_k} \quad [9]$$

6.5 X_OPTIMAL:

Each node calulate X optimal position of the cluster head with the help of weighted function.Formula that is used to calulate the X_optimal of the node given below[7].

$$Xi\ optimal = \frac{\sum_{k \in cluster} x_k w_{j,k}}{\sum_{k \in cluster} w_{j,k}} \quad [10]$$

6.6 Y_OPTIMAL:

Each node calulate Y_optimal position of the cluster head with the help of weighted function.Formula that is used to calulate the Y_optimal of the node given below[7].

$$Yi\ optimal = \frac{\sum_{k \in cluster} Y x_k w_{j,k}}{\sum_{k \in cluster} w_{j,k}} \quad [11]$$

6.7 FINAL X_OPTIMAL :

All the node present in cluster calculate X_optimal and Y_optimal .and send to the CH now CH calculatte the mean of X_optimal on the basis of the given formula below[7].

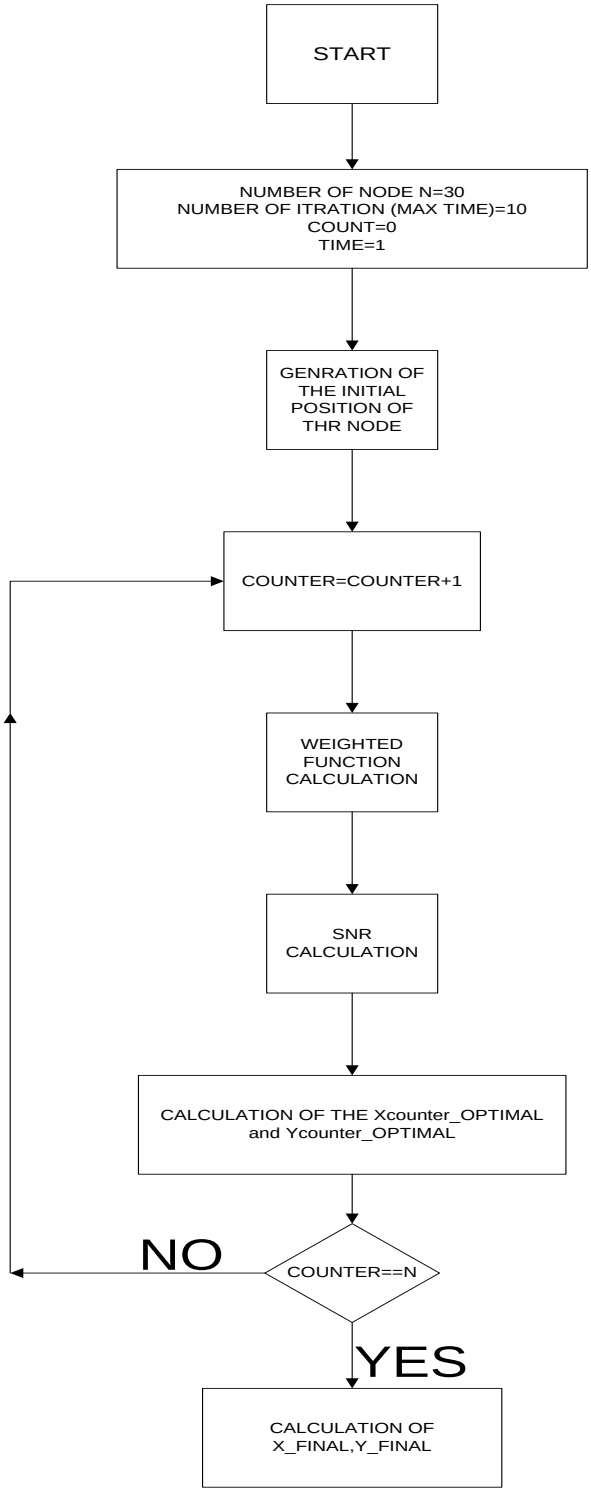
$$X^i_{optimal} = \frac{\sum k \in cluster X^i_{optimal,j}}{Ni} \quad [12]$$

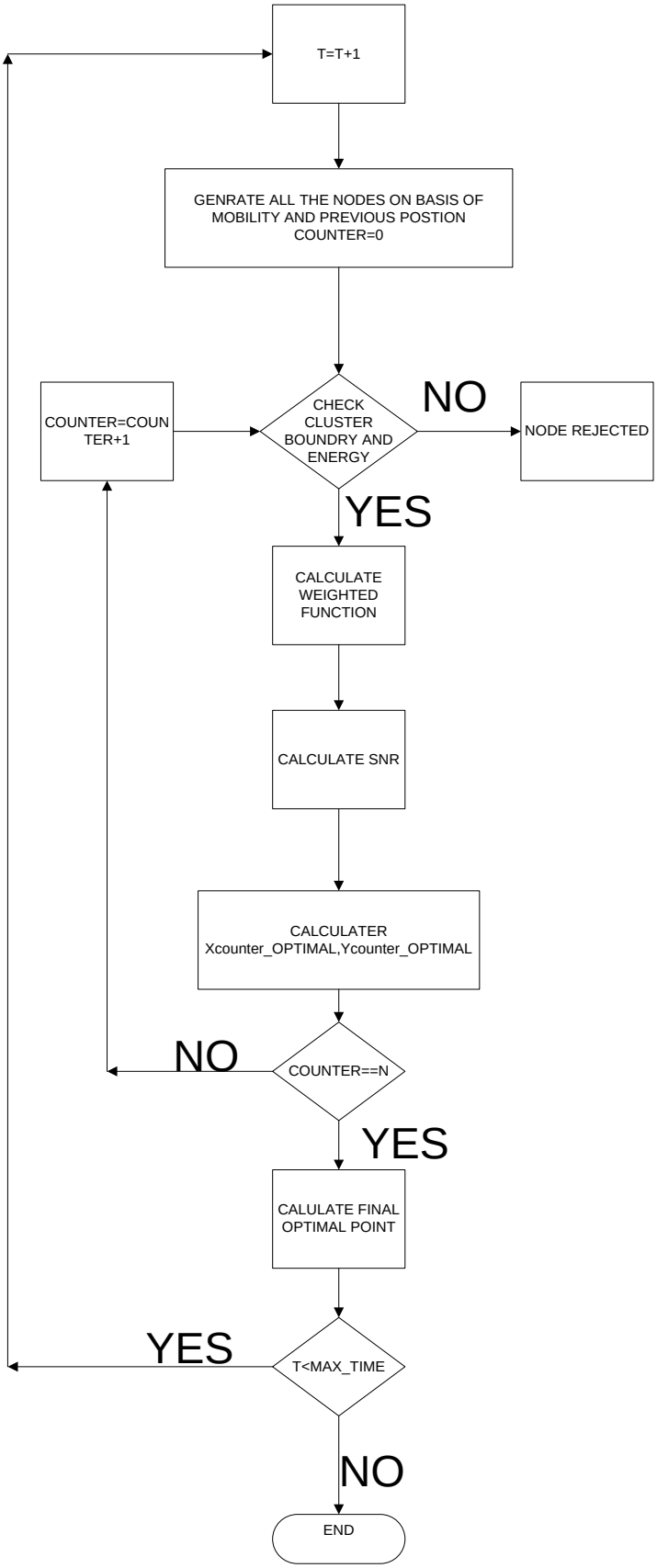
6.8 FINAL Y_OPTIMAL :

All the node present in cluster calculate X_optimal and Y_optimal .and send to the CH now CH calculatte the mean of Y_optimal on the basis of the given formula below[7].

$$Y^i_{optimal} = \frac{\sum k \in cluster Y^i_{optimal,j}}{Ni} \quad [13]$$

7. FLOW CHART


START
NUMBER OF NODE N=30
NUMBER OF ITRATION (MAX TIME)=10
COUNT=0
TIME=1
GENRATION OF THE INITIAL POSITION OF THR NODE
COUNTER=COUNTER+1
WEIGHTED FUNCTION CALCULATION
SNR CALCULATION
CALCULATION OF THE Xcounter_OPTIMAL and Ycounter_OPTIMAL
NO
COUNTER==N
YES
CALCULATION OF X_FINAL,Y_FINAL


T=T+1
GENRATE ALL THE NODES ON BASIS OF MOBILITY AND PREVIOUS POSTION COUNTER=0
COUNTER=COUNTER+1
CHECK CLUSTER BOUNDRY AND ENERGY
NO
NODE REJECTED
YES
CALCULATE WEIGHTED FUNCTION
CALCULATE SNR
CALCULATER Xcounter_OPTIMAL,Ycounter_OPTIMAL
NO
COUNTER==N
YES
CALULATE FINAL OPTIMAL POINT
YES
T<MAX_TIME
NO
END

In our proposed Firstly we generated the initial position of the node we assumed that in adhoc network each node have a GSM system. They know about their position.But in our programming we used uniform distributed random functions that generate random value of the nodes with in a limit (a-b). Each node has its own mobility we used uniform random distributed function to generate velocity of the node. Each node has different battery drain. We use uniform distributed random function to generate battery drain.

AT time T=1

In the starting we generated all the nodes there velocity and battery drain. Then for each node we calculated weighted function. During the calculation of weighted function we need to calculate SNR of each node corresponding other. After calculating the weighted function we calculate optimal position of the cluster head with respect to single node. We do this process for all cluster nodes. All nodes send their optimal position to cluster head .now cluster head take the mean of all optimal position and finally we get the final optimal position of the cluster head.

AT time T=2 TO T=max_time

In second iteration we generated new position of the each node present in the cluster on basis of their velocity and their previous position. In this iteration we also introduced a check on boundary value and energy of the node. We check the coordinate of node either node is present in the cluster or not if node is not present in cluster we did not proceed on it. And also check the energy of the node if a node having not enough energy or zero energy, treated as dead node, did not proceed this node. After generating the nodes position we will follow the same process that we followed in iteration 1 and calculated the optimal position of the cluster head.

8. EXPERIMENTAL RESULTS

Assumptions:

Number of Node =30

Number of iteration=10

We performed experiment on 30 nodes and done this process 10 times. We compare our cluster head with the another algorithm ***"A Novel Clustering Strategy For Efficient Routing In Ad-hoc Network***" proposed by gaurav chopra,satyan shrivastavaand abhay karandikar.

We calculated Cluster head positions generated by proposed approach and cluster head position generated by novel approach [7] and compare the results. We got cluster head generated by proposed scheme moves towards the node having less mobility and more energy and good signal to noise ratio (SNR) but in novel approach they did not concentrate on battery power of a node and mobility of the node. We did this process 10 times with 30 nodes. And we calculate the overall distance covered by cluster head in proposed approach is less than over all distance covered by cluster head in novel approach [7].

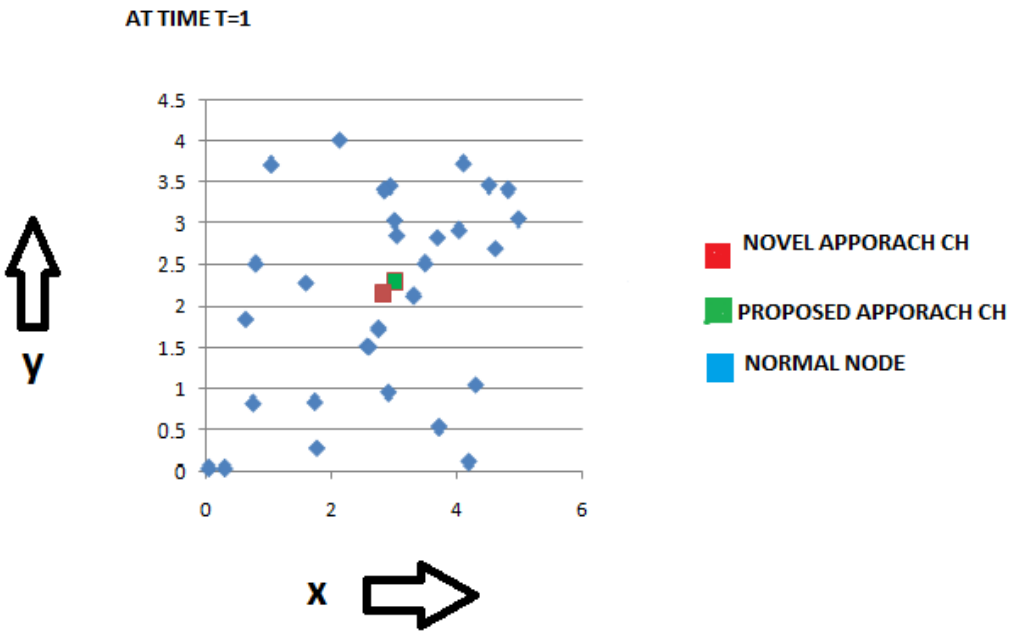


FIG 8.1 CLUSTER POSITION AT TIME T=1

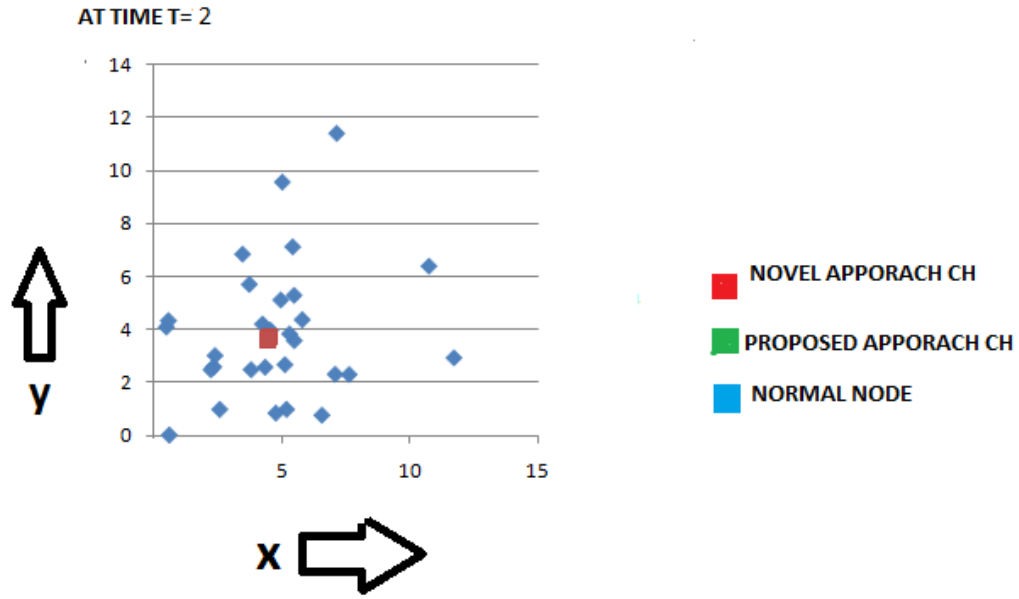


FIG 8.2 CLUSTER HEAD POSITION AT TIME T=2

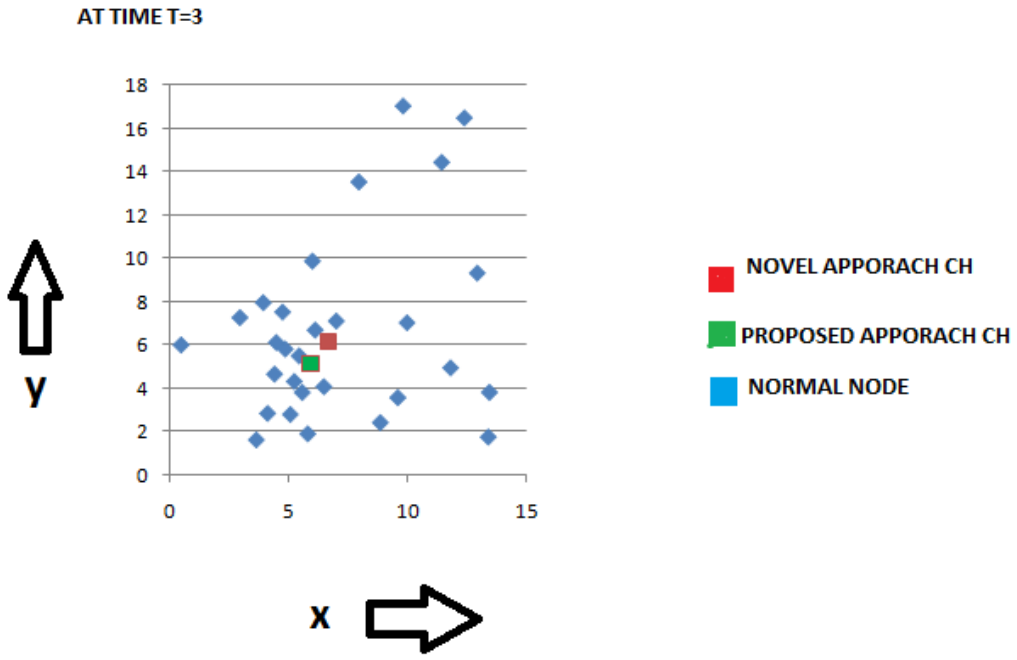


FIG 8.3 CLUSTER HEAD POSITION AT TIME T=3

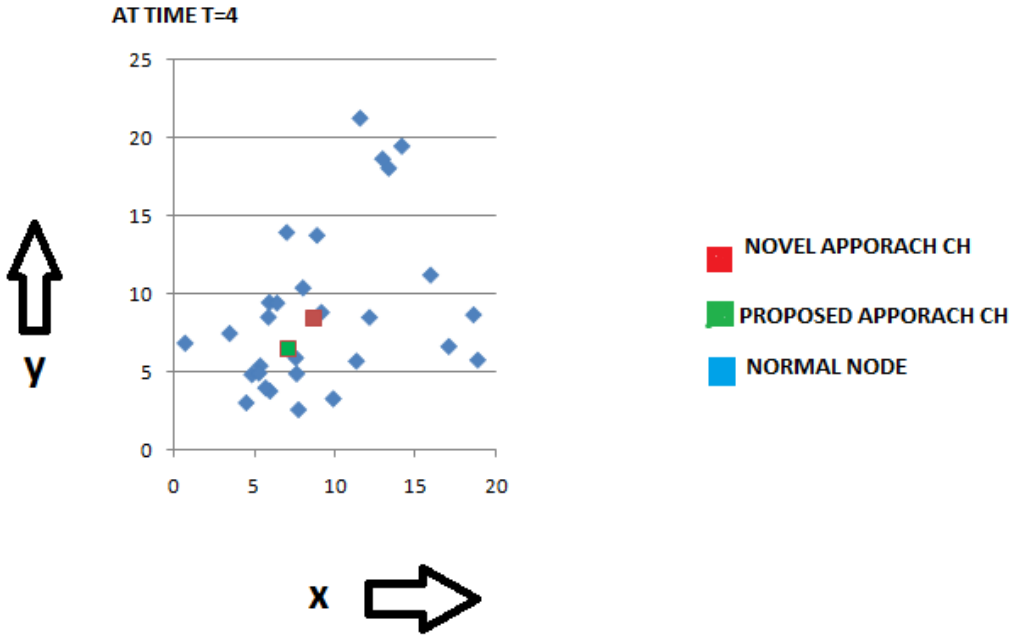


FIG 8.4 CLUSTER HEAD POSITION AT TIME T=4

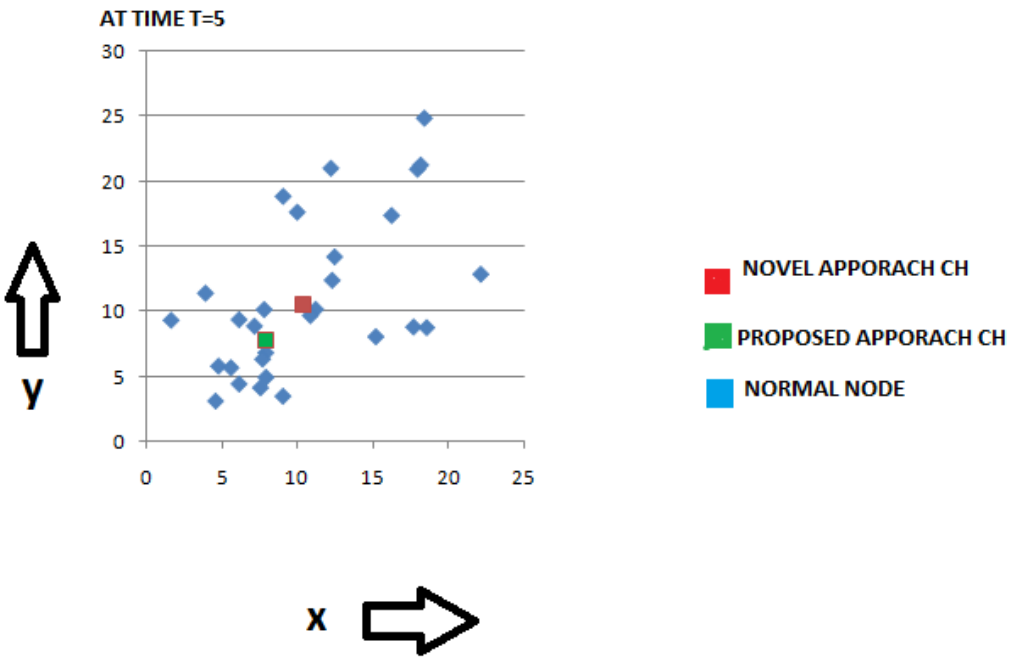


FIG 8.5 CLUSTER HEAD POSITION AT TIME T=5

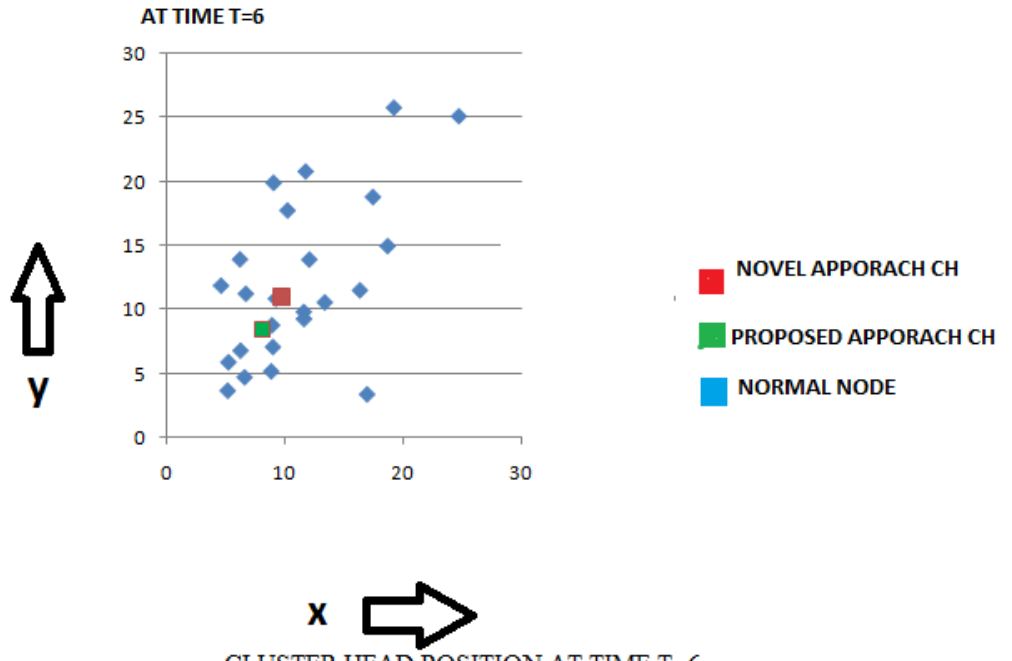


FIG 8.6 CLUSTER HEAD POSITION AT TIME T=6

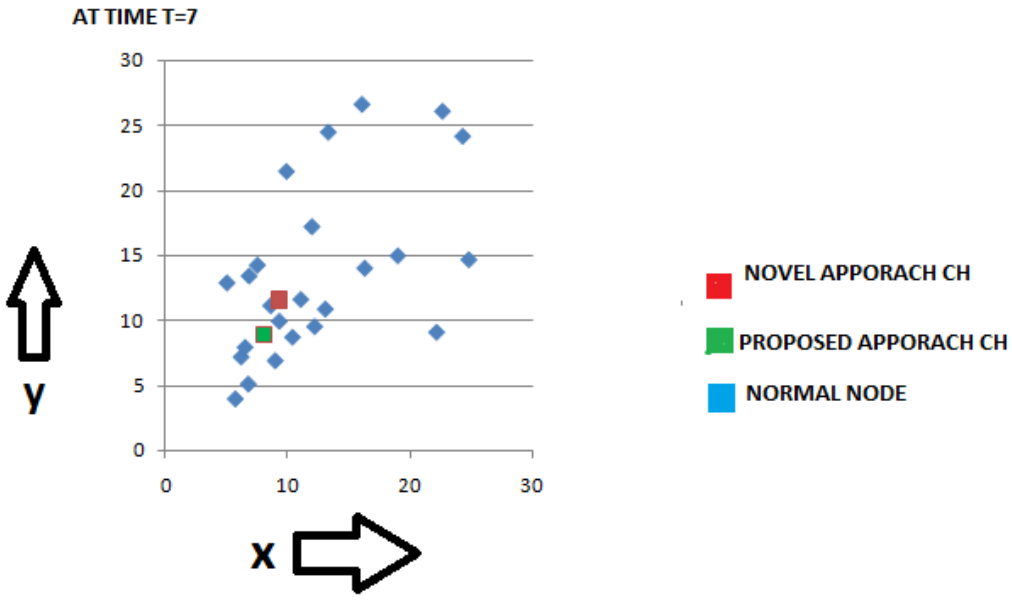


FIG 8.7 CLUSTER HEAD POSITION AT TIME T=7

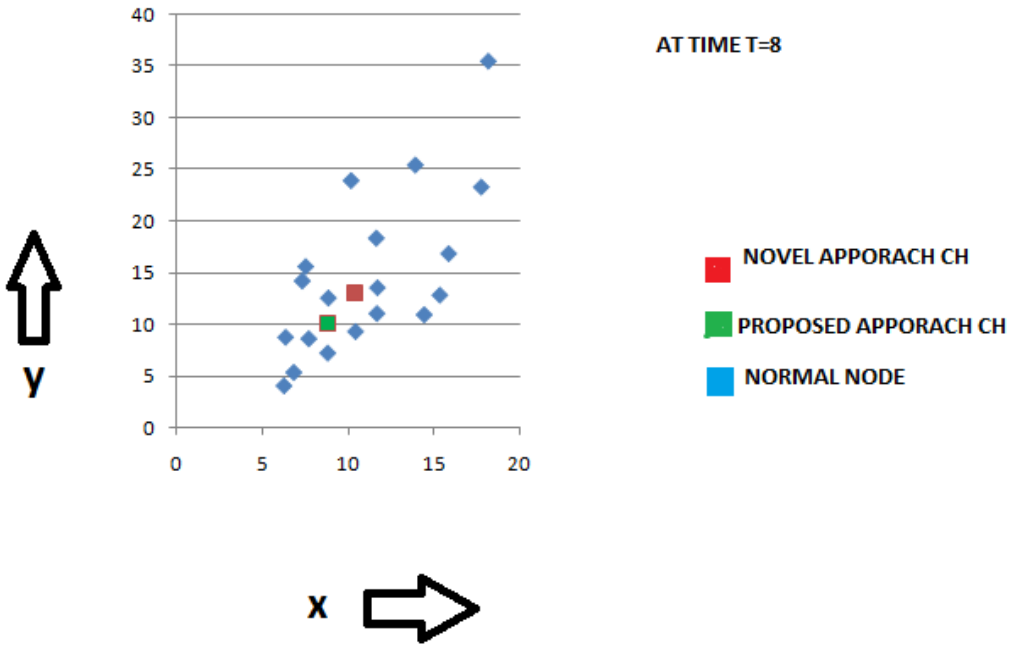


FIG 8.8 CLUSTER HEAD POSITION AT TIME T=8

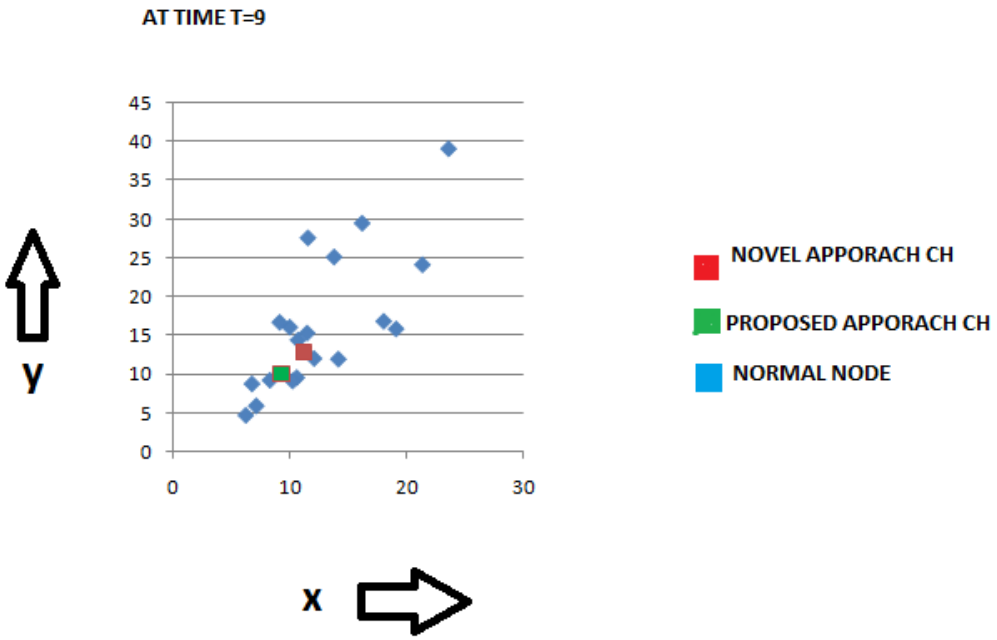


FIG 8.9 CLUSTER HEAD POSITION AT TIME T=9

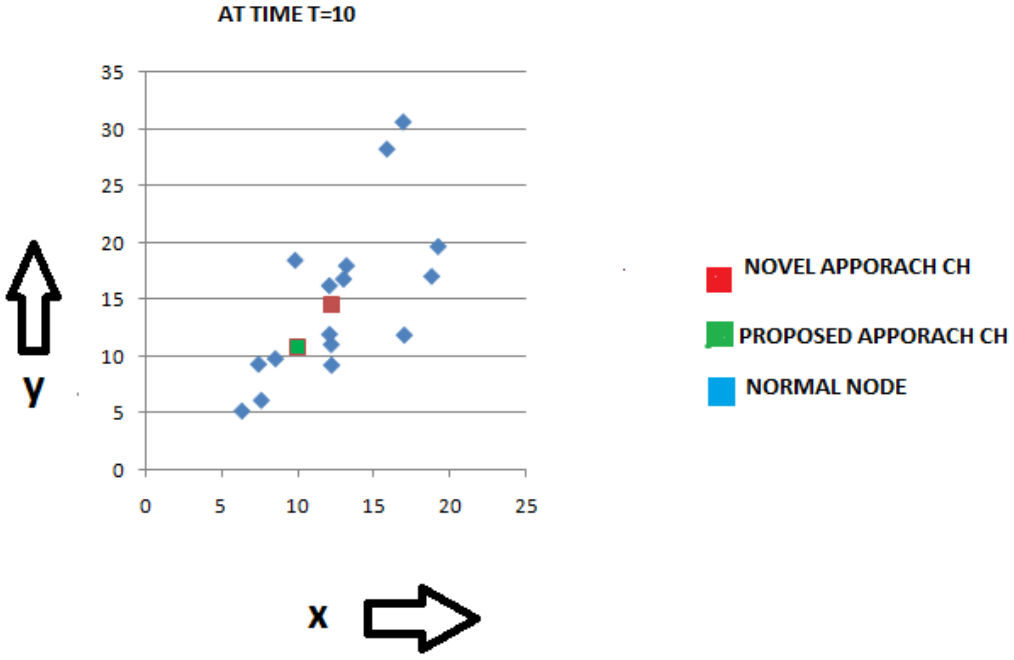


FIG 8.10 CLUSTER HEAD POSITION AT TIME T=10

TOTAL DISTANCE COVERED BY CLUSTER HEAD

For 10 iterations we calculated the distance covered by cluster head in both case. Total covered distance by cluster head in proposed approach is less as compare to total covered distance in given novel approach[7] that means cluster had selected by proposed is stable as compare to given approach[7]. For10 iterations total covered distance by both cluster head as shown in graph.

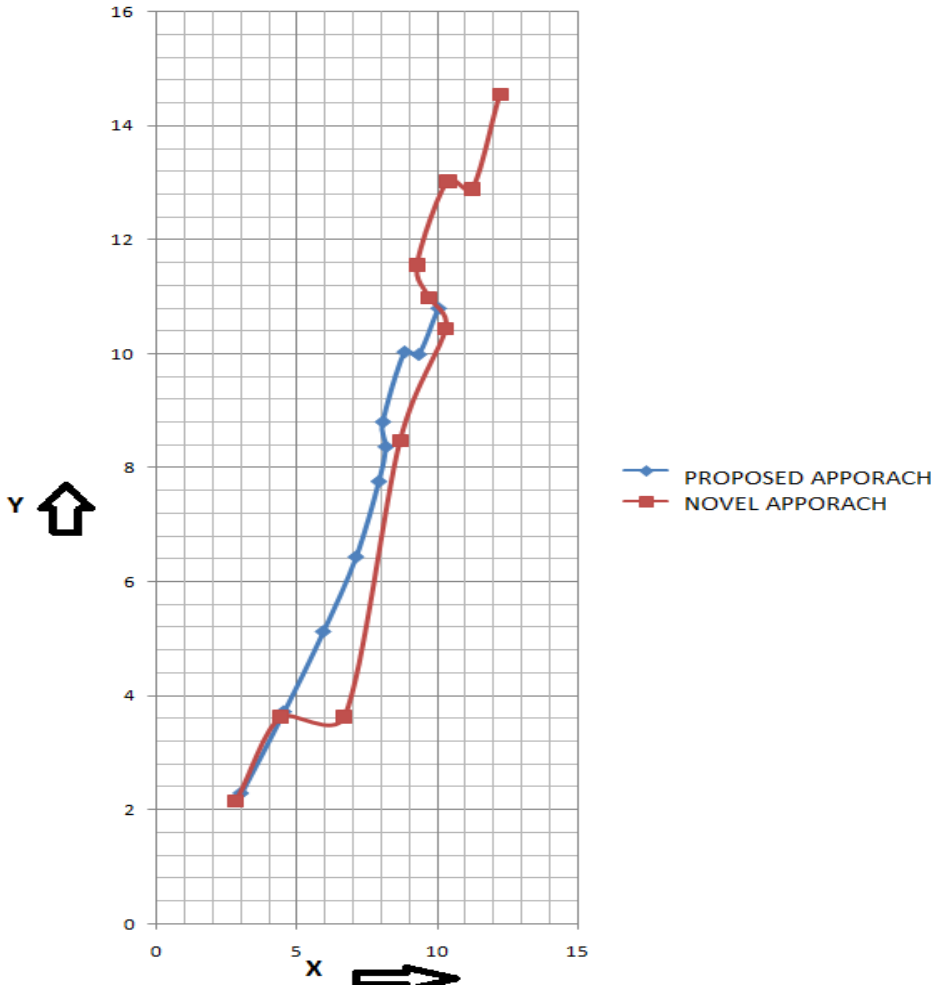


FIG 8.11 Distance Traveled by Cluster Head in Both Approaches

9. CONCLUSION

We have succeeded in achieving goals for cluster frame work stability and have shown that proposed approach provide stable cluster head. By selecting the stable cluster head we can make routing algorithm more efficient because most of the cluster based routing algorithm depend on Cluster head. Our approach does not assume any specific type of field. Due to the adaptive nature of this algorithm, there is no issue in dividing the field in to cluster.

10. FUTURE WORK

In proposed approach we used a voting algorithm in which each node send optimal position of the cluster head to old cluster head and then old cluster head calculated the final optimal position of the cluster head. There is an overheads issue with voting algorithm. There are lots of voting algorithms available we can use most efficient algorithm to reduce this overhead.

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11 APPENDIX A: Code Snippets

```
#include<stdio.h>

#include<conio.h>

#include<stdlib.h>

#include<math.h>

double uniform(double, double);

double Battery_use(int );

double distance(int ,int );

double weight_cal(int , int );

double snr_calculation(int , int );

double signal_power(int ,int );

double x_optimal(int );

double y_optimal(int );

void final_xoptimal();

void final_Yoptimal();

void clustehead_movment();

void totalcoverd_distance();

#define max_time 10

#define number_node 30

#define max 5

#define  min 0


double flag[number_node]={10};
```

//**Structure Of a Node**

```
struct Node
 {
        double x,y;
        double Broadcast_power,Battery_remain,Battery_drain;
        double mobility,maximum_velocity,aperture;
        double noise;
        double xoptimal,yoptimal;
        int status;
  double x_final,y_final;

 };
 int time=0;
 struct Node node[number_node];
 // **********main function**********//
 int main()
 {
    int i,j,count=0;
    double d,x[number_node],y[number_node],b[number_node],w;
   FILE *f1,*f2;
   f1=fopen("x_cordinate.dat","a+");
   f2=fopen("y_cordinate.dat","a+");
printf("\n\n\n");



for(time=0;time<max_time;time++)
```

```
{
   printf("\nat time=%d \n",time+1);
   f1=fopen("x_cordinate.dat","a+");
   f2=fopen("y_cordinate.dat","a+");
   fprintf(f1,"AT time t=%d\n",time+1);
   fprintf(f2,"AT time t=%d\n",time+1);
  if(time==0)
    {
         for(i=0;i<number_node;i++)
          {
              node[i].Battery_drain= uniform(0,1);
              node[i].Battery_remain= uniform(0,1);
              node[i].mobility=uniform(0,1);
              node[i].Broadcast_power=80;
              node[i].noise=20;
              node[i].x=uniform(min,max);
              node[i].y=uniform(min,max);

            fprintf(f1,"\n%lf",node[i].x);
            fprintf(f2,"\n%lf",node[i].y);
            }

        for(i=0;i<number_node;i++)
         {
         printf("x=%lf y=%lf  b=%lf m=
%lf\n",node[i].x,node[i].y,node[i].Battery_remain,node[i].mobility);
         }
```

```
            x_optimal(number_node);
            y_optimal(number_node);
            final_xoptimal();
            final_Yoptimal();
    fprintf(f1,"\n\n\n");
    fprintf(f2,"\n\n\n");
    fclose(f1);
    fclose(f2);
    }

 else
 {
         // f1=fopen("x_cordinate.dat","a+");
          //f2=fopen("y_cordinate.dat","a+");

       //printf("\nat time=%d \n",time+1);
       for(i=0;i<number_node;i++)
       {
            if(flag[i]<0)
              continue;
            b[i]= Battery_use(i);

            x[i]=(node[i].x-node[i].mobility)+((node[i].x+node[i].mobility-(node[i].x-
node[i].mobility))*uniform(min,max));
            y[i]=(node[i].y-node[i].mobility)+((node[i].y+node[i].mobility-(node[i].y-
node[i].mobility))*uniform(min,max));
```

```
            fprintf(f1,"\n%lf",x[i]);
            fprintf(f2,"\n%lf",y[i]);
        }
       for(i=0;i<number_node;i++)
       {
          node[i].Battery_remain=b[i];
          node[i].x=x[i];
          node[i].y=y[i];

      if(node[i].x<min||
node[i].x>4*max||node[i].y<0||node[i].x>4*max||node[i].Battery_remain<0.000001)
      {

        flag[i]=-10;
      }
     if(flag[i]<0)
     continue;
     else;
 //printf("\n  xi=% lf   yi=% lf    moblity= %lf     b=% lf",node[i].x,node[i].y,node[i].mobility,b[i])
;

      }

 for(i=0;i<number_node;i++)
    {
    if(flag[i]<0)
    printf("\nnode is out of limt=%d",i+1);
```

```
     }
//printf("\n");
    x_optimal(number_node);
    y_optimal(number_node);
    final_xoptimal();
    final_Yoptimal();
    fprintf(f1,"\n\n\n\n");
    fprintf(f2,"\n\n\n\n");
    fclose(f1);
    fclose(f2);
  }
  }
clustehead_movment();
totalcoverd_distance();
/*printf("b=%lf  v=%lf",node[2].Battery_remain,node[2].mobility);
w=weight_cal(2,6);
printf("\n weight= %lf", w);*/
getch();
}
```

// End of The Main Function

// Random Number generator…..

```
double uniform(double a, double b)
{

      return rand() / (RAND_MAX + 1.0) * (b - a) + a;
}
```

// This Function Calculate Remaining Battery of a Node

```
double Battery_use(int i)
{
                    node[i].Battery_remain = (node[i].Battery_remain) -
(node[i].Battery_remain*node[i].Battery_drain);
            //printf("b=%  lf\n",node[i].Battery_drain);
   return  node[i].Battery_remain;

}
```

// This Function Calculate Distance Between Two Nodes..

```
double distance(int i,int j)
 {
          double x,y,distance_d=0;

   distance_d= sqrt(pow((node[i].x-node[j].x),2)+pow((node[i].y-node[j].y),2));
   //printf("d=%lf",distance_d);
   return distance_d;
 }
```

/// This Function Calculate Weighted Funtion

```
double   weight_cal(int j, int k)
 {
      double w=0;
            int A=1,B=1,C=1;
            if(flag[j]<0||flag[k]<0)
              return w;
            else
            w= (A/snr_calculation(j,k))+(B*node[k].Battery_remain)+(C/node[k].mobility) ;
              //printf("\n weightrd value(%d,%d)=%lf",j,k,w);
            return w;

}
```

// This Function Calculate Signal to Noise Ratio….

```
 double  snr_calculation(int i, int j)
     {
           double snr;
           snr= signal_power(i,j)/node[i].noise;
           //printf("\nSNR of  node(%d,%d)=%lf",i,j,snr);
   return snr;
              }
```

// This Function Calculate Signal power of a Node

```
double signal_power(int i,int j)
      {
            double signal_power=0;

             signal_power=((node[i].Broadcast_power)/4*3.14*pow(distance(i,j),2));

            //printf("\nsignal power of node(jk)=%lf",signal_power);
             return signal_power;
    }
```

// This Function Calculate X_ Coordinate off the Cluster Head with respect to Single Node

```
double x_optimal(int i)// here i= maximun number of naode in cluster
 {
          double sum=0,weight=0;
   int j,k;
   for(j=0;j<i;j++)
    { sum=0;
      weight=0;
            for(k=0;k<i;k++)
            {
               //   printf("%lf ",node[k].x);
       if(j==k)
              continue ;
```

```
                sum=sum+(node[k].x)* weight_cal(j,k);
                //printf("\n%lf  %lf\n ",node[k].x,weight_cal(j,k));
         weight=weight+weight_cal(j,k);
         //printf("\n sum and weight value(%d,%d)=%lf    %f",j,k,sum,weight);
              }
              if(sum==0&&weight==0)
                 node[j].xoptimal=0;
        else
         node[j].xoptimal=sum/weight;
              //printf("\n Xoptimal for node %d=%lf",j+1,node[j].xoptimal);
    }
printf("\n");}
```

// This Function Calculate X_ Coordinate off the Cluster Head with respect to Single Node

```
double y_optimal(int i)// here i= maximum number of node in cluster
 {
          double sum=0,weight=0;
   int j,k;
   for(j=0;j<i;j++)
    { weight=0;
      sum=0;
            for(k=0;k<i;k++)
            {
       if(j==k)
             continue ;
```

```
            sum=sum+node[k].y* weight_cal(j,k);
            weight=weight+weight_cal(j,k);
            // printf("\n weightrd value(%d,%d)=%lf    %f",j,k,weight,sum);
      }

            if(sum==0&&weight==0)
              node[j].yoptimal=0;
             else
        node[j].yoptimal=sum/weight;
           // printf("\nYoptimal for node %d=%lf",j+1,node[j].yoptimal);
     }
           printf("\n");
   }
```

// This Function Calculate final X_ Coordinate off the Cluster Head

```
void final_xoptimal()
{
int i,count=0;
double sum=0;

FILE *fl;
 fl = fopen("our_results.dat", "a+");
for(i=0;i<number_node;i++)
          {
    sum=sum+node[i].xoptimal;
```

```
            if(node[i].xoptimal==0)
     count++;
    }
    sum=sum/(number_node-count);
    node[time].x_final=sum;
            fprintf(fl, "\n at time = %d\n",time);
            fprintf(fl, "\n optimization point for X= %lf",sum);
  fclose(fl);
  printf("\ngiven_final_Xoptimal=%lf",sum);

}
```

// This Function Calculate final Y Coordinate off the Cluster Head

```
void final_Yoptimal()
{
int i,count=0;
double sum=0;
FILE *fl;
 fl = fopen("our_results.dat", "a+");

for(i=0;i<number_node;i++)
   {
                    sum=sum+node[i].yoptimal;
                     if(node[i].xoptimal==0)
```

```
                count++;
   }
          sum=sum/(number_node-count);
          node[time].y_final=sum;
          fprintf(fl, "\n optimization point for y= %lf",sum);
  fclose(fl);
printf("\ngiven_final_yoptimal=%lf\n\n",sum)
}
```

// This function Calculate over Distance Covered by Cluster Head

```
void totalcoverd_distance()
{
    double sum=0;
    FILE *fl;
 fl = fopen("our_results.dat", "a+");
    for(time=1;time<max_time;time++)
     {
         sum=sum+ sqrt(pow((node[time].x_final-node[time-
1].x_final),2)+pow((node[time].y_final-node[time-1].y_final),2));

       }
         fprintf(fl, "\n distance covered by cluster head\n D= %lf",sum);
       fclose(fl);
 printf("\n total cover distance=%lf",sum);
}
```