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Enhancing Energy And Life Time Of Wireless Sensor Network Based On Cluster Intra And Inter Optimum Path Routing Algorithm

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Abstract

A wireless sensor network is an ad hoc network that has collection of wireless sensor nodes scattered over an area to gather physical properties such as humidity, temperature, pressure, stress and so on. This information is then forwarded to base station or sink node. The sensors battery may not be a chargeable one and when battery drains then sensor fails and new sensors are replaced. The existing LEACH protocol extends the life time of sensor by clustering concept. In our proposed system minimum numbers of sensor nodes are activated based on the area coverage and they are grouped as different cluster. In this a intra and inter optimum route path selection is established to maximize wireless sensor network life time .An intra optimum route path is established by member node to reach cluster head node within the cluster and inter optimum route path is established by the cluster head node to reach the sink node either directly or through gateway nodes present in the other clusters. A fuzzy logic is applied in optimum route path selection for selecting minimum number of nodes with sufficient energy

level for transferring packets in wireless sensor networks. All nodes in the wireless sensor network should be utilized effectively so as to avoid drain in energy level of particular nodes. To estimate the performance, simulations are performed. As a result, we examine that our protocol optimum route is more efficient than the other routing protocols.

Keywords: - LEACH protocol, intra and inter optimum path selection**,** Hireachial routing protocol

1. Introduction

Now a day's wireless sensor networks play a major role in collecting information from sensors and sending to the sink node. Sensor networks are deployed in various areas such as healthcare monitoring, civil building application, and military defenses. Wireless sensor networks can sense information humidity, pressure, temperature etc .These sensors collects information about the surroundings then process the information and send to base station (BS) [1].

Internet of Things (IoT) is the emerging technology that are used in various application such as health care smart cites, vehicular networks, machine to machine communication and other areas . In IOT uses RFID to uniquely identify things and controlling them with various mechanisms. IOT is used in pervasive computing i.e. present everywhere that gather information for all IOT device component and processes these information. Networking Scientists, Research & Development industries, and many other business organization are developing an achievable and robust architecture to make it commercial and it is used by normal people [2, 3].

Wireless sensor Networks comprises of three main parts such as communicating unit sensing unit and processing unit. The sensing unit has analogue to digital converter that converts analog signal to digital signal and sensors for sensing information they are powered by battery and replacement of these battery is difficult as most sensors are deployed in typical areas where human cannot enter such as volcanic environment, military area surveillance, etc. As energy drains sensors fails since replacement of battery is not possible then we need to deploy new sensory to make it WSN active. Next the communication unit is responsible for sending data over a sensory channel. At last, the processing unit has some microcontroller and a microprocessor, which controls the sensor nodes by sending control signals to microcontroller and a microprocessor.

In order to minimize battery energy conception sensor nodes has limited coverage and the sensors that are not in coverage area of base station can communicate through intermediate sensor nodes. However, some case the wireless sensors nodes are organized as different clusters and the cluster head is

responsible to collect information from cluster area and send to base station. It indicates the separation of data into groups of cluster head data. To maximize life time all sensors sends their gather information to cluster head and these cluster head aggregate these information and send to the base station

Only cluster head is responsible for gathering information process them and sending to the sink node this saves the energy of other sensor nodes as they are going to send information to cluster head and they are not going to do any processing. The cluster head also plays a vital role in wireless sensor network. It reduces the redundant information while aggregating data from different sensor nodes. In general if anything happens it is detected by multiple sensors deployed around the environment. As this information is Send to cluster head, it eliminates the redundant information and forward to sink Node. Thus it reduces the bandwidth requirement of wireless sensor network as sending information is reduced and it also saves the energy of Sensors node [5].

The sensor near to base station can directly transmit its information to it. If it is On hop transmission. Generally much of Sensor nodes are deployed far away from base station and they com communicate only through neighbor Sensor nodes. This is multi hop transmission and it requires dynamic topology creation in Wireless sensor network [6}

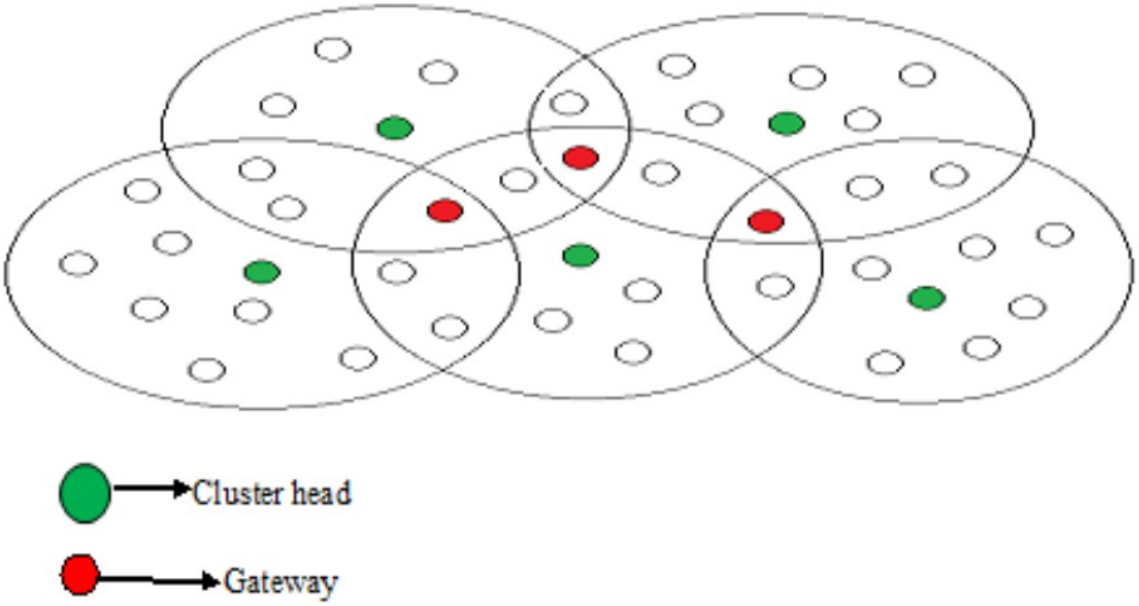
The cluster formation and grouping member Sensor nodes with the cluster head is a major problem in wireless Sensor Network. As much of work such as collecting sensory data, aggregating it, removing redundancy and sending to the base station are done by cluster head. This lead to drain in energy level of cluster head and soon it become unavailable. Then a new cluster head is detected [7].

Aggregation is a process, where data is collected in whole and transmits to the BS [13,14]. A typical WSN mainly comprises of four components such as [13] sensing element, [14] ADC, [15] processing unit, [16] power unit [11]. A sensor acts as a sensing element used to sense physical parameters. ADC is a converter type used to convert analog signals to digital. Processing unit is mainly used for computational purposes and processing data. Finally a power unit is responsible for maintaining each node's power supply [15]. Energy efficiency is the major drawback in constructing a WSN network. Energy conserving is main criteria, while transmitting long and continuous messages. Senor batteries only preserve a little much of energy and it is not possible to change the battery, so that little energy must used efficiently, data packet routing activity drains most of the energy resources[16,17].

2. Proposed System

The nearby nodes around a fixed area are organized as cluster and Node with high energy level is elected as a cluster Head (CH) Node. Then intra optimum route path selection Algorithm is performed by member nodes to establish a optimum route path to cluster Head Node. A fuzzy logic is applied for Selection of intermediate nodes to reach cluster head logic criteria

Fig 1 cluster formation in wireless sensor networks



2.1CLUSTER INTRA AND INTER OPTIMUM PATH ROUTING ALGORITHM :-

```
Routine intra_optimum_route_path_selection( )
{
    For_each (Member_Node MN)
        Establish optimum route path to cluster head Node (CHN) with minimum sensor nodes &
        sufficient energy levels .
    End_for
}
```

```
Routine inter_optimum_route_path_selection ( )

{
    For_each (cluster_Head _Node CHN )
        Establish optimum route path to sink node directly or via  gateway nodes  indirectly.
        Gateway nodes are selected with sufficient energy level
    End _for
}
```

2.3 Fuzzy Logic Criteria

S.No	Traffic	Distance	Energy
1.	Low	Low	High
2.	Low	Medium	High
3.	Medium	Low	High
4.	Low	Low	Medium
5.	Low	Medium	Medium
6.	Medium	Low	Medium
7.	Medium	Medium	Medium

Table 1.1 fuzzy logic criteria

The first preference in fuzzy logic is given to Energy level. The nodes with higher energy level are chosen first. The second preference is given to traffic, a node with lower traffic is selected. Third preference is given distance to reach the cluster Head node.

A nearby node to other cluster with sufficient energy level is selected as the gateway Node (GN) . Each cluster will have a gateway node to communicate to nearby neighbor clusters.

The cluster near to Sink node can directly communicate to base station. The other cluster head node communicate to base Station using intermediate other cluster gateway node minimum distance intermediate clusters are selected for the communication to base station

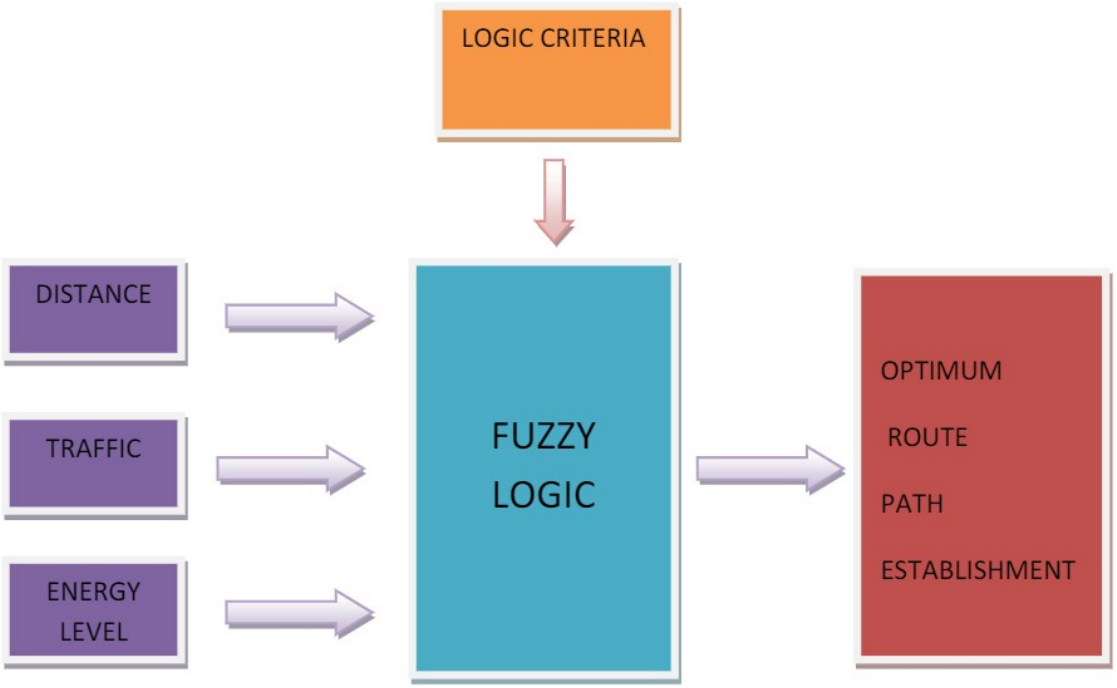


Fig 2. Block diagram of optimum route path establishment

2.4 Cluster Head Selection Algorithm Steps

Step1: Each sensor node around the building initially consider them as cluster head and record their residual energy level in ENERGY_ADV advertise packets

Step2: Then ENERGY_ADV advertise packet is shared among their neighbour node sensors.

Step3: When other sensor nodes receive ENERGY_ADV advertise packets then the decision are taken based on their residual energy level and received advertise energy level.

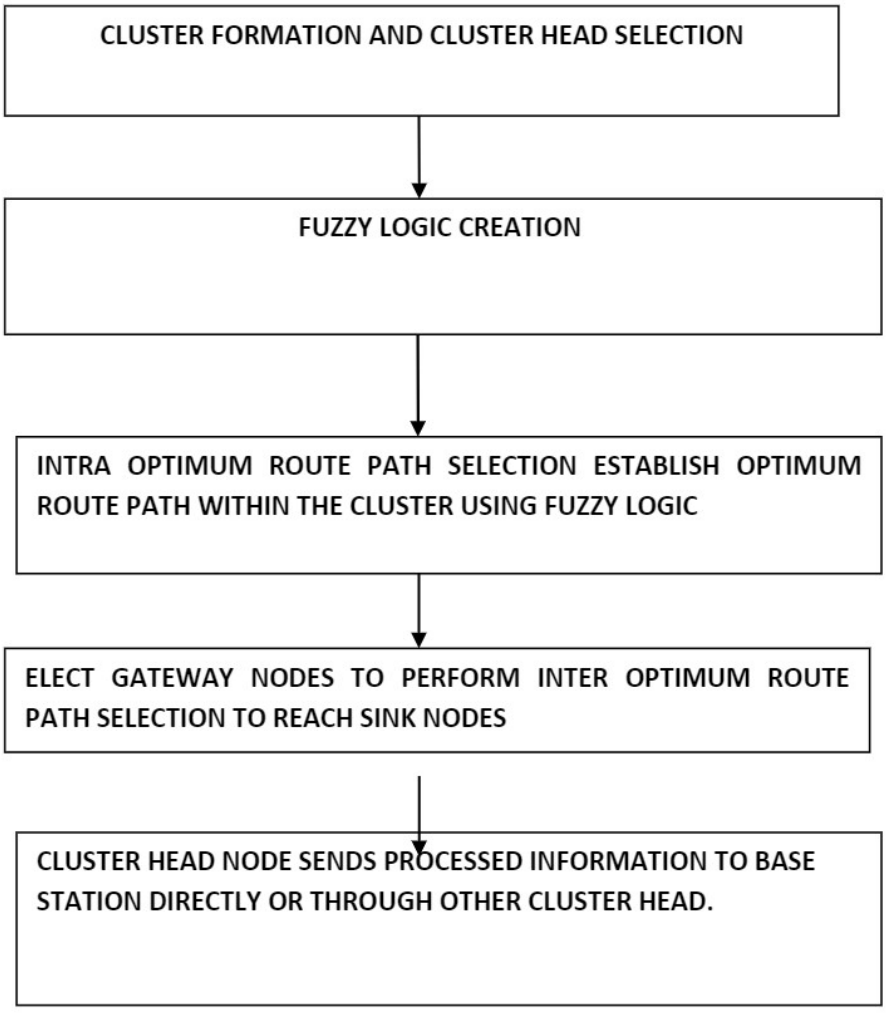
Step 3.1 if advertise ENERGY_ADV packet residual energy is higher than sensor node's own residual energy then assign advertise node as Cluster Head and update energy level and broadcast to all other neighbor node except sending sensor node.

Step 3.2 if advertise ENERGY_ADV packet residual energy is smaller than the sensor node's own residual energy then there is no updating and just forwards to the sending sensor node

Step4: After a particular time period, all sensor nodes have a same ENERGY_ ADV packet with same id and energy level and it is chosen as Cluster Head.

Step5: Repeat step2 cluster head energy level becomes low.

Fig 3 flow chart representation Cluster Head Selection Algorithm



3. Simulation Result and Analysis:

a. POWER CONSUMPTION:

At initial stage cluster head makes only few sensor in active state and rest are inactive . When there is a need i.e. when something went wrong,based on our requirement more sensors on particular area or time are activated to gather more amount of information .This will drastically increase efficiency and reduces the power consumption. The combination of LEACH and hierarchical cluster formation will produces better result in structural building monitoring sensor. Now we compare the result of normal LEACH and our proposed system based on power consumption.

Table2. Represents the comparison between the existing leach Algorithm and proposed method

No of nodes	Power consumption	
	LEACH	Proposed
40	22	20
45	26	23
50	29	25
55	33	29
60	36	32
65	39	36
70	43	38
75	44	40
80	46	41
85	49	43

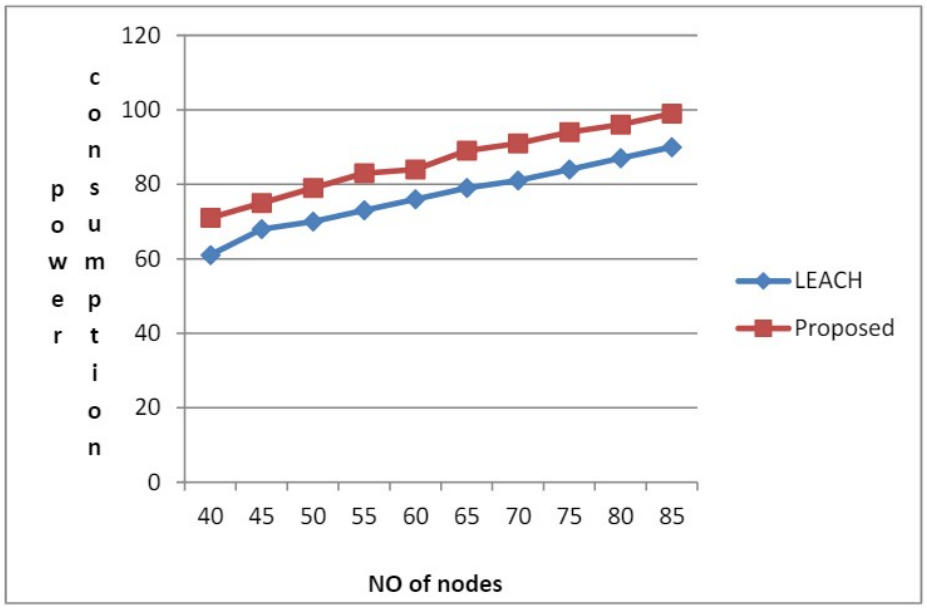


Figure 4 represents the plot between number of nodes & Power consumption

b. INFORMATION GATHERING:

The amount of information collection is also increased since we are isolating all information collected by different sensors by information collection node and send to cluster head node in turn it forward to sink node either directly are through intermediate cluster head sensor nodes. The neural network is used to gather environment information effectively from cluster member nodes and duplicate information are avoided before sending to cluster head nodes

Table2. Represents the comparison between the existing leach Algorithm and proposed method

No of	Information

nodes	Gathering (in %)	
	LEACH	Proposed
40	61	71
45	68	75
50	70	79
55	73	83
60	76	84
65	79	89
70	81	91
75	84	94
80	87	96
85	90	99

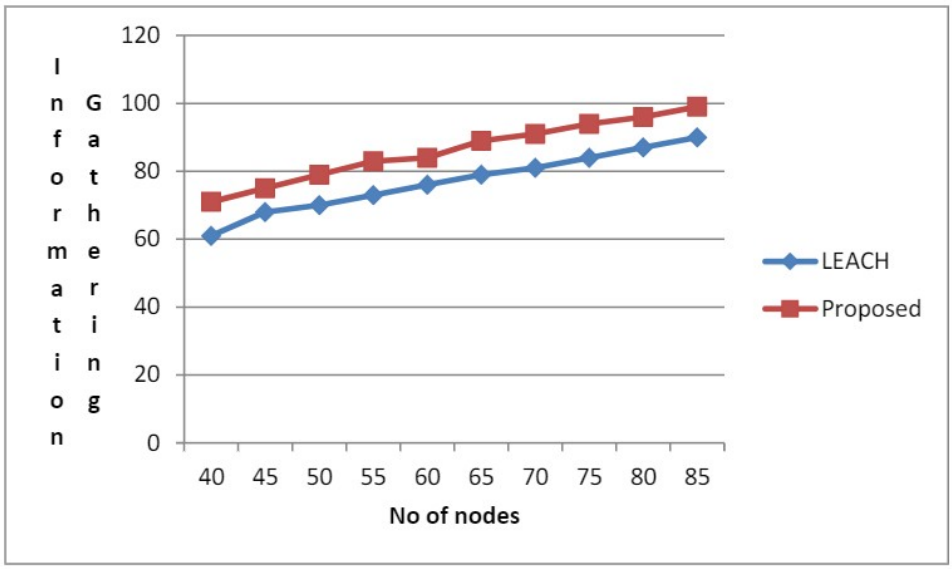


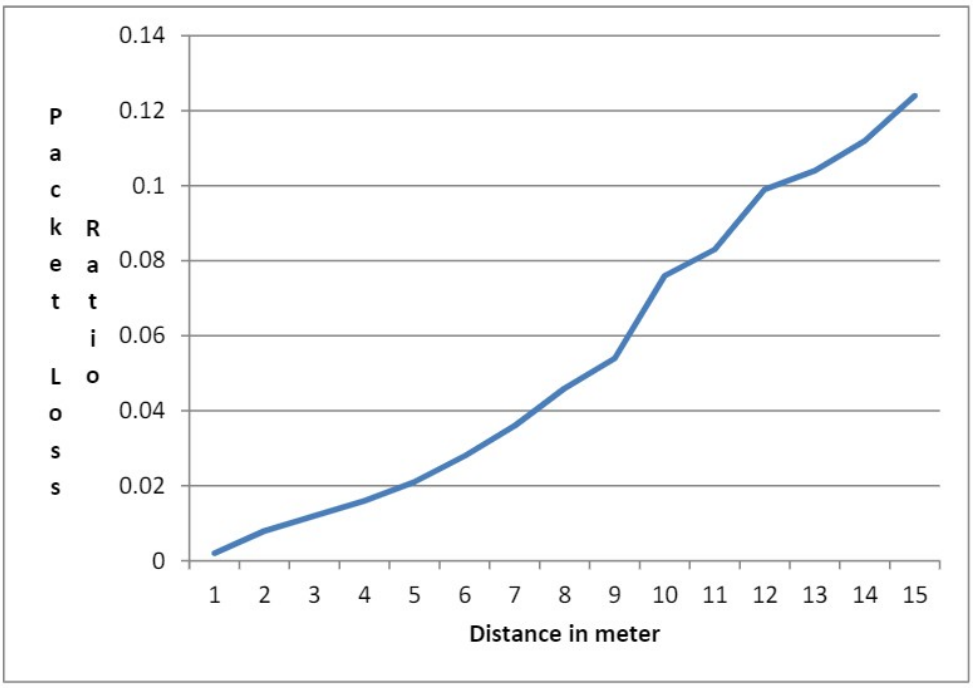
Figure-5 represents the plot between number of nodes & Information Gathering

C. Packet Loss Ratio

As the distance increase a few packets may be damaged due to external noise interference and this can be tolerable as we can recognize information using other correctly received packets in the sink node. Moreover if the distance increases the number of nodes in between source node and sink node increases and there may be loss of packets.

DISTANCE	PACKET LOSS RATIO
1	0.002
2	0.008
3	0.012
4	0.016
5	0.021
6	0.028
7	0.036
8	0.046
9	0.054

10	0.076
11	0.083
12	0.099
13	0.104
14	0.112
15	0.124



4. Simulation parameters

Parameter	Default value
Simulation area	130 m × 130 m
Number of nodes	60–120
Packet length (from cluster head to BS)	6500
Ctrl Packet length (default packet length from normal node to cluster head)	195
Initial energy	0.45
Base station coordinates	(50, 50)
Probability to the node to become a CH	0.15
Energy for transferring of each bit	49*0.000000001
Energy for receiving	49*0.000000001
Energy for free space model	11*0.000000000001
Energy for multipath model	11*0.000000000001
Energy for data aggregation	5*0.000000001

In this cluster Head node is select based on the energy level analysis by cluster selection algorithm. All Sensor nodes collect the environmental data and do some initial processing and send the Information Isolation Node in cluster. Based on the processed data collected from each Sensor node, the cluster Head node takes decision and forward to Base Station using time division multiplexing or code division multiplexing.

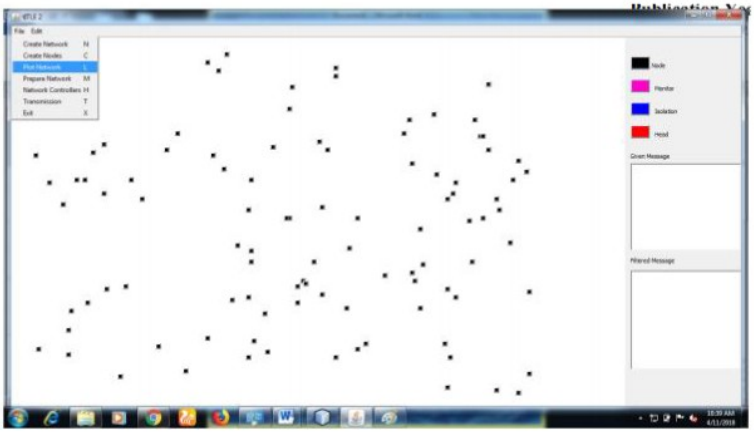


Figure-6 represents the node creation

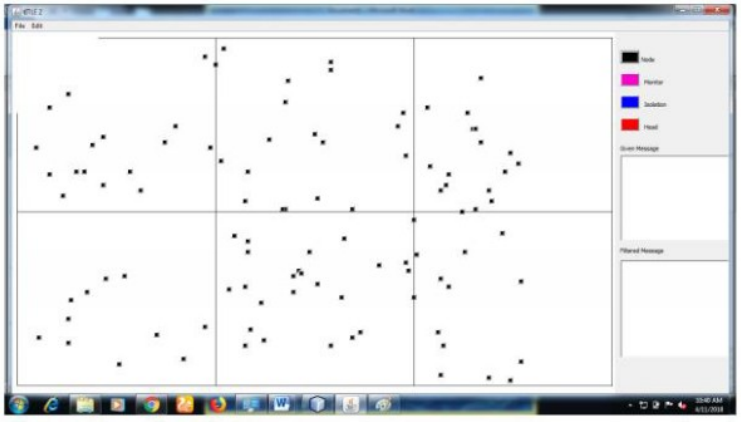


Figure 7 represents the cluster node formation

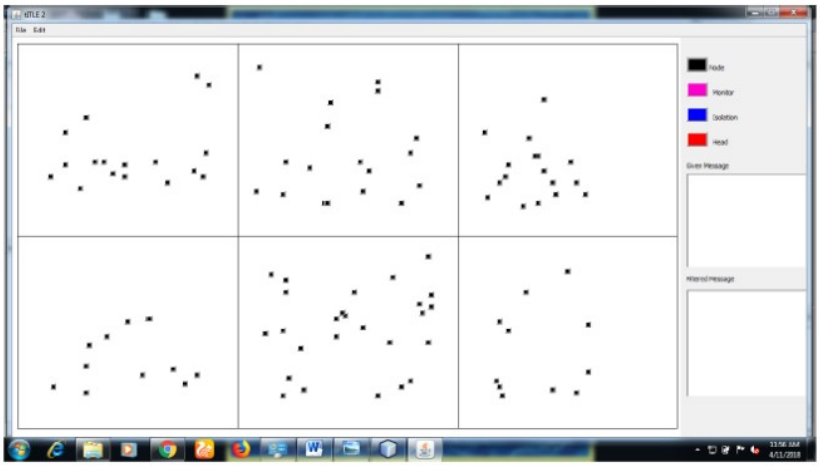


Figure8 represents partially active nodes in cluster

5. Conclusion

The combined effort of LEACH Protocol and hierarchical routing protocol increase the life time of wireless Sensor Network and effectively communicate the sensor information to the base station for building monitoring System. The LEACH protocol initially makes some of sensor node in active State and makes some sensor to be switched off. This will reduce the power consumption of wireless sensor network. When a unusual circumstance arises then it will activate some more sensors in that area to collect more information and send to Sink node for further effective measures. The hierarchical routing protocol makes some cluster information for effectively collecting and communicating to the sink node. The cluster head performs data aggregation and process them to make decision and convey to sink node. The information isolation node and energy monitoring node in cluster reduces the work load of cluster head and increases the life period of cluster head node. As a result the wireless sensor network efficiency is increased of about 8 percentages than the existing LEACH protocol.

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