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Energy Efficient Clustering In Wireless Sensor Networks

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Abstract
Wireless sensor network is the group of sensor nodes that may be in a well-defined manner or may be in any fashion performs the function related to the environment by sensing the environment through sensor nodes and transfer the data forward to the sink for taking the necessary decisions. Due to the random and thickly distributed it is difficult to recharge or to replace the battery of a node or even the node. For this reason the major design challenge for this is the energy efficient for these networks. In this paper a new approach of selecting the cluster head for sending the data to the base station has been proposed. The selection of cluster head is based on the distance between the nodes and that value is updated into the routing table of the target node. Then the residual energy is considered for the selection of cluster head . then the packet loss is taken into the consideration if the nodes are having same residual energy and at last he trust factor is taken into the consideration for the selection of cluster head .The performance of proposed algorithm compared with other known algorithm is shown .
Key words: WSN, Energy Efficient , Clustering protocol, Cluster head , routing protocol

1. Introduction:

Wireless sensor network are the collection of sensor nodes that perform the function of collecting the data from the environment forwarding it to base station via other nodes or directly by itself. The nodes may sense the same information in the environment more than one times leading the wastage of battery. For this purpose the repeated data is not allowed to move forward by the sensor network by the process of filtering that unnecessary data and the repeated data. The nodes in the wireless sensor network have some range and within this range the nodes can sense or gather the information and pass it to the base station. The infrastructure of the wireless sensor network consists of the following components :

Sensing elements : these are those elements that perform the function related to the sensing of the environment.

Processing element : are those elements that perform the processing of data sensed by the sensing elements. The main function of this is to filter the unwanted and repeated data.

Communication elements : are those that perform the function of receiving and transmission of data. The nodes perform the function of both sensing of data as well as forwarding this data to the other nodes. The range of sensor node is some fixed so each node senses the data individually and forwards it to the sink or to the base station. The architecture of the wireless sensor network is shown in the Fig 1 [1][5]

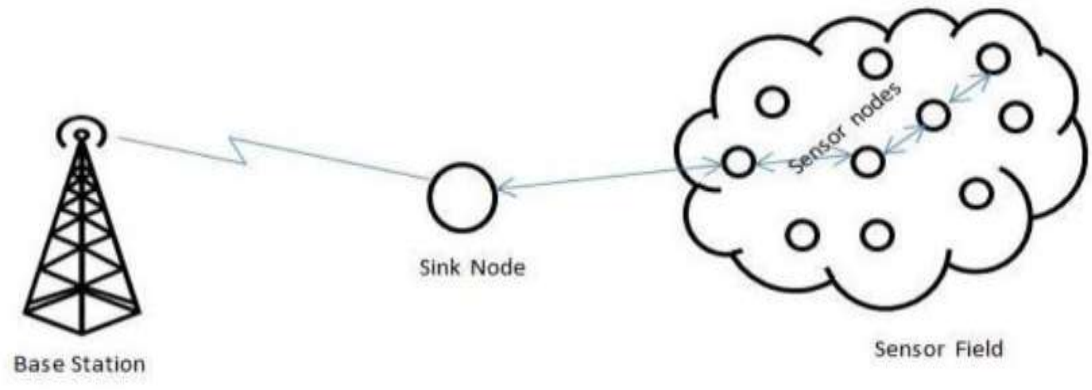


Fig 1 architecture of WSN

The main part of wsn is the sensor that performs the function of sensing the environment. The sensor is the aggregation of the following components: controller, power supply, memory, sensors, and communication devices (transceivers)[1].

- *Controllers*: It performs the tasks related to controlling of functionality includes the collection of data of other sensors node.
- *Communication Device (Transceivers)* : Performs the function of both the transmission and reception of data collected by the sensors. A sensor node performs the function of both the transmission/ reception of data as well as sensing of environment. It can works in different states as :-

  Transmit state: used for the transmission of data

  Receive state: used for reception of data

  Idle state: in this mode it is ready to receive but is not receiving any data and is used for reducing power consumption

  Sleep state: in this state , critical parts of the transceiver are switched off
- *Power* supply: Sensor nodes are generally supplied power through in built some small battery device.
- *Memory*: Sensor nodes contains small memory element for storing the information gathered from sensor nodes. So that the filtering of data can be done.
- *Sensors*: for sensing the environmental data. This acts as the interface between the sensor network and the environment.

  The diagram of the sensor node is in Fig 2

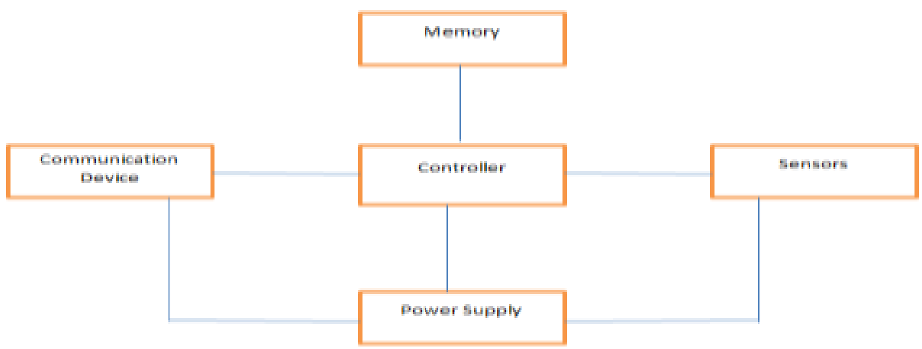


Fig 2 architecture of a sensor node

2. Proposed Protocol

2.1 Assumption

The whole network is assumed to be random in nature with the number of nodes are distributed randomly and varies between 10 and 100. Each node in the network is placed in a 1000 * 1000 grid with 100J initial energy.

2.2 Proposed Design

The proposed approach uses social impact theory for the calculation of trust of each node. The clustering technique is easy to implement and requires weights which must be calculated based on various performance parameters.

Weight Calculation

Weights for the routing are calculated by considering various factors:

Distance between the Nodes: Distance between the two nodes is calculated using the Euclidean Distance formula. The x and y coordinates for a node is known and the distance between two nodes is calculated and updated in the routing table of the target node. The Euclidean distance formula is given by

$$d_{ij} = \sqrt{(x_i - x_j)^2 + (y_i - y_j)^2}$$

Where $i \text{ and } j$ are the nodes whose distance needs to be calculated.

Residual Energy: The energy left with each node after the transmission of data is termed as residual energy. The energy consumed is a combination of transmission and receiving energy, sleep power etc. With every transmission and reception of data the node's energy is consumed and the residual energy is considered for the calculation of weight.

Packets in the network: Packets lost on a node which either works as a source node or the path node are calculated. Packet loss is due to some attack on the node or the overflow of packets or expiry of time to live parameter of a packet. Each node in a network consists of a fixed length queue and if the queue of the node is full then packets start dropping and thus the overflow occurs. Time to live (TTL) parameter is associated with each packet and decreases as the packet passes through a node.

Trust : Trust of a node is the most important parameter in the calculation of weights. The trust of a node is calculated using the social impact theory which states that the trust of a node depends on the number of previous interactions of a node. A social rank of each node is calculated using the parameters like residual energy and the packets lost by the node in the network. Firstly each node is assigned an initial trust value ranging from 0.7- 0.95 with 1 as the highest trust value. Then the trust of a node is increased if the social rank value of the node is greater than the threshold and decreased otherwise.

The weight of each node is defined as the summation of the residual energy, packets and distance between the nodes multiplied by some constant value and the trust value. This constant value is based on the weightage given to each parameter.

Routing Table

Routing table associated with each node contains the important information regarding path selection and the neighbors. This information includes the next hop neighbor, routing weight and the destination used.

3. Proposed Algorithm

1: $Initialize\ each\ node\ with\ trust\ value\ (between\ 0.7 - 0.95)$

$$2: for\ i \leftarrow 0 : n\ , n\ is\ total\ number\ of\ nodes$$

$$3: \quad for\ j \leftarrow 0 : n\ \forall\ j\ \neq i$$

$$4: \qquad W_{ij} = CalWeight(\ S_i, S_j), where\ S\ is\ set\ of\ data\ required\ to\ calculate\ weight\ for\ node\ i$$

$$5: \quad end\ for$$

$$6: \ end\ for$$

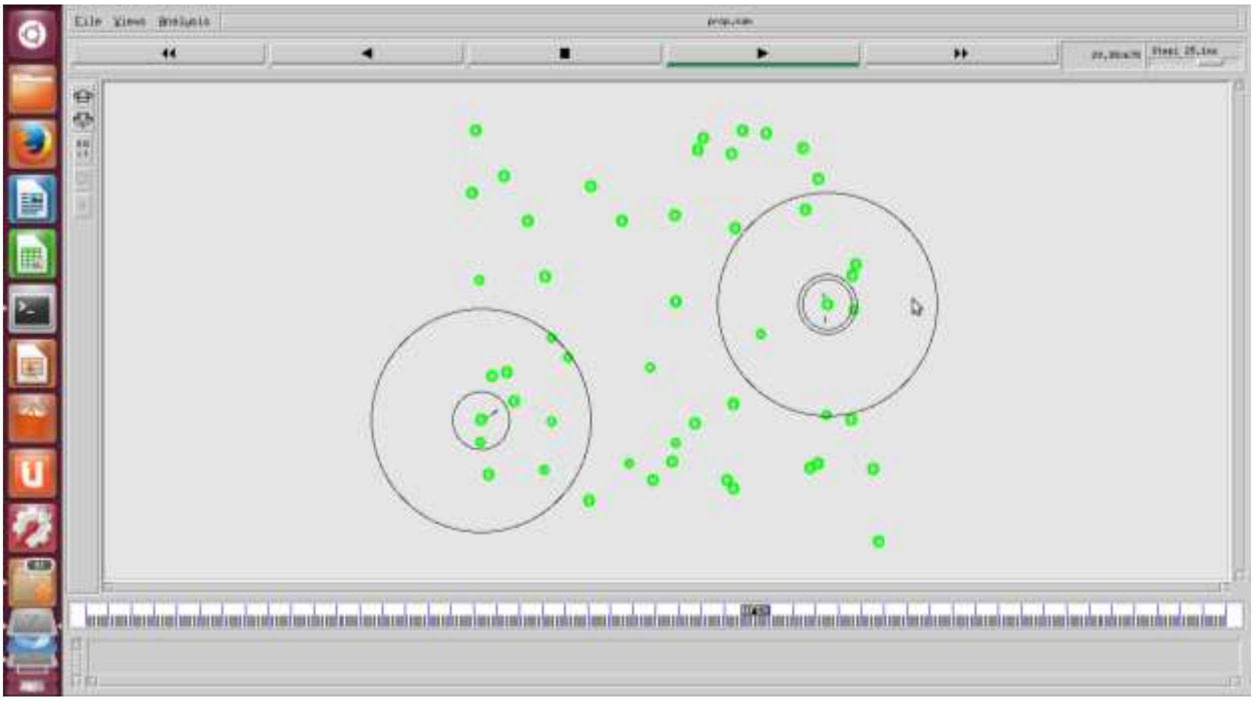
$$7: FindNodes(n), \qquad for\ clustering\ on\ the\ basis\ of\ weights$$

$$8: TransferData(n_s, n_d)$$

$$9: GoTo\ 2$$

4. Performance Evaluation

The below mentioned parameters are used for the evaluation of the performance of the proposed approach.
Number of Alive Nodes: The total number of nodes remains in the network after a particular round.
Residual Energy: Residual Energy in the network after the transmission of data in the network.
To evaluate the performance of the proposed approach on the basis of the above mentioned performance parameters Network Simulator ns-2.35 is used. The simulation parameters are given in table 1.



Proposed energy efficient Clustering in WSN

Table 1: Simulation Parameters

Number of Nodes	Variable (20 – 100)
Dimension of Grid	1000m * 1000m
Radio Range	210 m (approx.)
Packet Size	512 Bytes
Simulation Period	50 sec
Physical Layer	PHY 802.11

Number of Alive Nodes

Fig3 shows the graph of number of alive nodes plotted against the number of communication rounds. The graph shows the comparison of the basic approach with the Social Impact Theory Optimizer Algorithm approach. It is evident from the graph that the performance of the proposed approach is better than the basic approach as the number of rounds increases, this is due to the decrease in the residual energy of nodes in the network.

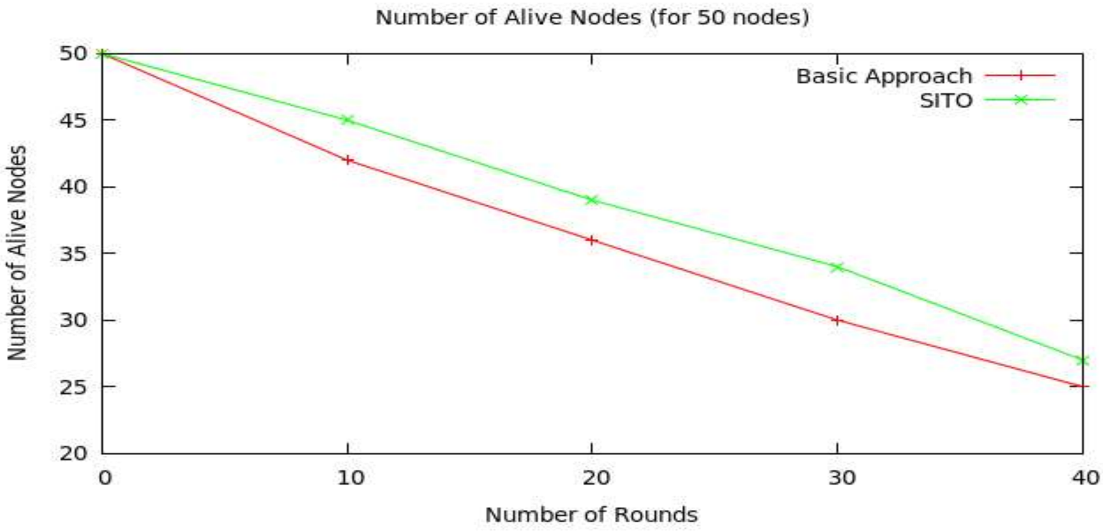


Fig 3 Number of alive nodes

Residual Energy

Fig4 and 5 shows the graph of residual energy of nodes in the network. In figure 4 the residual energy is plotted against the number of communication rounds in the network. As the number of rounds increases, the residual energy of nodes decreases. In the figure 5 the residual energy is plotted against the number of nodes in the network. As the number of nodes in the network increases the energy required is divided among nodes in the network.

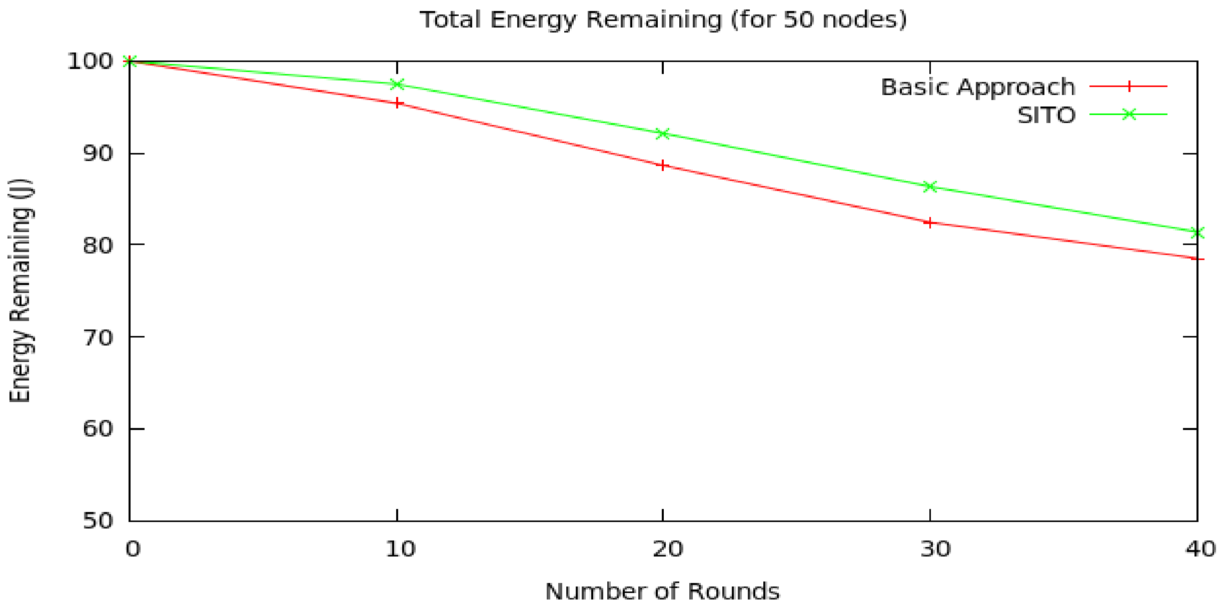


Fig 4: Energy Remaining vs Number of Rounds

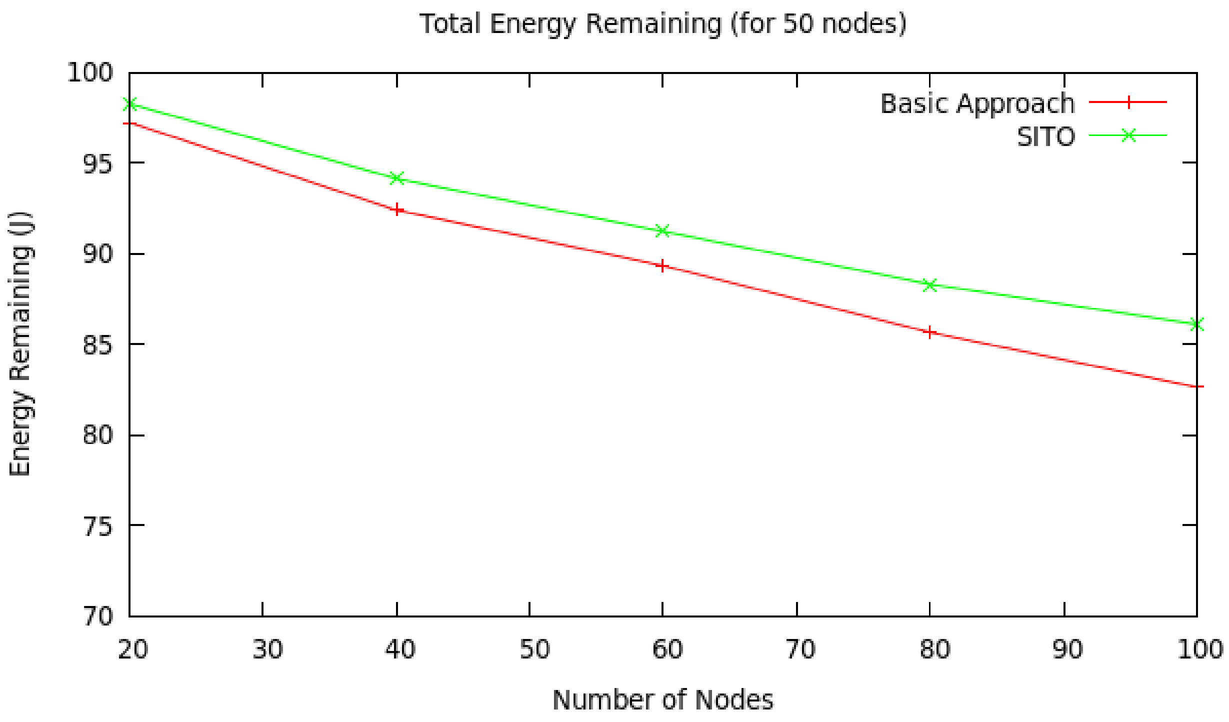


Fig 5: Energy Remaining vs Number of Nodes

5. Conclusion

IN this paper we proposed the energy efficient algorithm in the selection of cluster head for the better and longer life of the network and is energy efficient than the proposed one. From the results it can be seen that the proposed algorithm is energy efficient and increases the lifetime of the network.

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