Enhanced Kangaroo based Routing protocol for WSN with Energy Efficiency

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Abstract: WSN is the wireless sensor network where various sensor nodes will senses the data and will transmit that data to the base station. While having transmission the path will be identified from source sensor node to the base station. This path will be an efficient route. In hierarchical routing protocols the whole network area will be sub divided into smaller clusters. Each cluster will be having randomly distribution of the sensor nodes based on various parameters like concentration, distance and remaining energy the cluster head will be selected. Each sensor node will send the data to the cluster head and then to the base station. Fuzzy based approach with genetic will further strengthens the cluster head selection criteria. So that best path will be identified. While adopting this criterion all the parameters like Energy dissipation, dead nodes count and Alive Nodes count will be enhanced compared to the Kangaroo.

Keywords: Kangaroo, Fuzzy, WSN, Energy Efficient.

I. INTRODUCTION

Wireless Sensor Networks (WSN) is the innovation that comprises of expansive number of small sensor hubs disseminated in a specially appointed way. Sensors are by and large spread over a land range in profoundly thick way. These sensor hubs are of ease and low power which can perform different capacities [2].

In WSN, the sensor nodes are deployed in a sensor field. The deployment of the sensor nodes can be random (i.e. ropped from the aircraft), regular (i.e. well planned or fixed) or mobile sensor nodes can be used. Sensor nodes coordinate among themselves to produce high-quality information about the physical environment. Each sensor node bases its decisions on its mission, the information it currently has and its knowledge of its computing, communication and energy resources. Each sensor nodes collect the data and route the data to the base station. All of the nodes are not necessarily communicating at any particular time and nodes can only communicate with a few nearby nodes [6]. The network has a routing protocol to control the routing of data messages between nodes. The routing protocol also attempts to get messages to the base station in an energy-efficient manner.

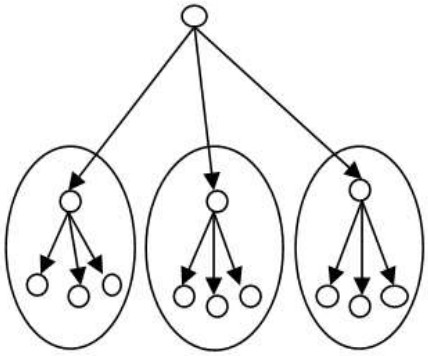

Fig. 1 Hierarchical sensor networks[3]

1.1 There are various characteristics that are available for the networks are

- Densely Deployed Sensor Nodes:- The sensor nodes are deployed in the area in highly dense order. So that the nodes can collect the data from its environment more precisely [3].
- Sensor nodes are battery powered:- Sensor nodes are battery power operated. They have less power to cover up so they dissipate after fixed interval of period. Battery power will get lost when large numbers of transmissions are receiving of the signals [3].
- Limited energy, Storage and computation constraints:- Each sensor node is a small device having sensors for both transmissions are receipt of the signal. They are also of lower cost. That means having less memory. Which can fill after the interval of time[3].
- Self configurable:- In initial sensor nodes are randomly deployed. They even can be thrown from the aeroplane in large area. Later on with the help of localization techniques they are being configured so that they can transfers the data [2].
- Application Dependant:- This network oriented WSN is application oriented. Because for any type of application they are being set. So that the transmissions are receipt can be taken place.
- Unreliability of sensor nodes:- They are lower cost network. So there is a chance of network failure. Also there is no central controller which can control the

network configuration. So there is higher number of chances of network failure.

- The frequent change in topology:- While the nodes are randomly distributed there is a chances that there is frequency fading or isolation of node because of the absence of the relay node. Under such circumstances there requires the topology change so that node fading can be avoided.
- No Global identity:- Each node is lying in the network as individual node. There is no central identity to the node. So that system cannot be configured with global identity [1].

1.2 Hierarchical Routing

LEACH is one of the protocols based on hierarchical routing. Where sensor network will be sub divided into smaller clusters. Each cluster will be distribution of the sensor nodes randomly. One node based on probability and remaining energy will be selected as cluster head. Sensor nodes will transmit the data to the cluster head and then cluster head the data will be transmitted to the base station. This way data will be aggregated at the cluster head. It will make use of energy more efficiently.

1.3 Fuzzy based selection

Based on [1] the researcher has followed three basic parameters to evaluate the sensor node being eligible for cluster head. The main objective will remain as to enhance the life time of the network and nodes. The Fuzzy parameters are like remaining battery power, mobility and distance to the base station. These parameters will be checked for selecting a node to be the cluster head for the data aggregation sent by the sensor nodes. As the distance between the node grows the more amplification is done so more energy will be consumed at the intermediate nodes. So while applying the Fuzzy Rule set the distance consideration will reduce the energy requirements.

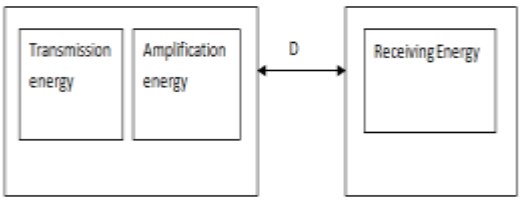

Fig. 2 Fuzzy Model[1]

1.4 Kangaroo based approach

Genetic algorithms are a type of algorithm is to find out the optimal solution to given problem. This optimal solution produces either the maximization or minimization a particular function. The genetic based approach includes various basic steps like [1].

- Build a fitness function.
- Select a population of chromosomes.
- Select those chromosomes which can reproduce.
- Crossover the selected chromosomes to generate next population of new chromosomes.
- Select the next generation chromosomes randomly [3].

1.5 Energy Model

The sensor nodes are being distributed in the network area. The total network area will be sub divided into smaller parts. Each small part is denoted as cluster. Based on various parameters the cluster head will be selected. Each time the sensor node sends the data to the cluster head. Cluster head will receive the data and send that data to the either second level cluster head or to the base station. Each sensor node and the base station are based on battery power. The transmitter consumes the energy in transmission to run the electronics. Similarly receiver will also consume the energy will receiving the data because it has to run the electronics. So energy or batter power is consumed for transmitting l bits to the distance. This distance is the measured distance between transmitter and the receiver given in equation 1.

$$E_{Tx}(l,d) = E_{Tx-elec}(l) + E_{Tx-amp}(l,d) = \begin{cases} l*E_{elec} + l*\varepsilon_{fs}*d^2 if d < d_0; \\ l*E_{elec} + l*\varepsilon_{mp}*d^4 if d \geq d_0; \end{cases}$$

(eq. 1)

E_{elec} denotes the energy dissipation by the transmitter and receiver for transmitting per bit. E_{fs} and E_{mp} are the features of the transmitter amplifier.

As the distance between the transmitter and receiver is greater than the threshold the free space model of d^2 is used. Otherwise multipath fading channel model d^4 is used.

II. LITERATURE SURVEY

Nayak and Vathasavai(2017): author has proposed a energy efficient technique for enhancing the life time of the node and network. This paper has proposed a Fuzzy based cluster and super cluster head selection. This selection is based on various parameters like remaining battery power, mobility, and distance to base Station. While considering the distance as one parameter will definitely reduces the transmission energy requirement also reduces the amplification energy.

Yongsheng Ding et al (2016): author has proposes the event driven multipath routing based scenario for the wireless sensor network. This type of network has dynamic cluster selection. This cluster will be having random number of nodes. So that randomly one node will be selected as cluster head. The dynamic cluster head based on requirements will save lot of energy for both cluster preparation and cluster head selection[2].

Anjali et al (2015): author in this paper has proposed a distance adaptive threshold sensitive Energy Efficient sensor network protocol. In this network improvement over to the APTEEN is performed. While considering the time thresholding which is soft thresholding. Distance is considered while selecting the cluster head from the cluster.

That node will be considered cluster head which has minimum distance amongst each other[3].

Shio et al (2010): author has studied various routing protocols used in the wireless sensor network. So that there inter comparison based on life time and the energy can be compared. Based on study heirarical routing protocols are best suited for the situation to save the energy. It is the protocol which is consisting of LEACH, TEEN, APTEEN, DAPTEEN etc. in each protocol clusters are divided and sensor nodes are randomly being distributed in the network area. One node based on residual energy will be selected as cluster head. All the sensor nodes will send the data to the cluster head and then to the base station[4].

III. ALGORITHM

i. Subdivide the network area of size M*M in N number of clusters.
ii. Distribute the nodes randomly in the network each cluster.
iii. Based on genetic model select one node to be the optimal for being a cluster head. The set parameters for genetic will be concentration, residual energy and distance.
iv. Send the data from sensor nodes to the cluster head. At cluster head data will be aggregated.
v. Based on the distance to the base station or the distance to other cluster head in other cluster which ever will be minimums transmitted.
vi. BS will collect whole data and chin of transmission will be terminated.

IV. FLOWCHART

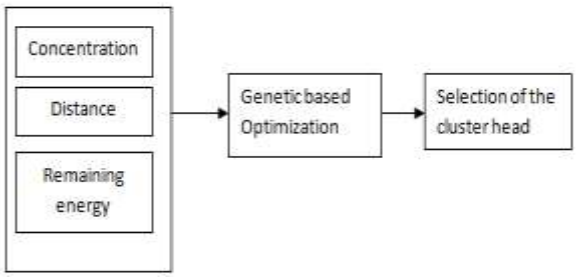

Fig. 3 Flowchart

V. PSEUDO CODE

Test case set S= θ
For each coverage C do
Find start node, Ns
Repeat

Find 100 neighbors by adding one step into ∑ of Nc
Select the best fitness neighbor among the 100 neighbors based on fuzzy logic
If the best fitness neighbor is in useful then
Nc<- the best fitness neighbor based on three fuzzy parameters
Ekse
Brea
End if
Until satisfy C or reach maximum iteration
S=SU(∑ of Nc)
End for

VI. KANGAROO ALGORITHM

- **Population**:- Population is consisting of the network solutions. Higher is the population size the higher is the accuracy of the genetic algorithm. Initial population is randomly selected.
- **Fitness Function**:- Fitness value of each individual is calculated based on the fitness function. Various variable parameters are being used for the function. Like.
  i. Remaining energy (E).
  ii. Concentration(Density)(D)
  iii. Distance between sensor node to the cluster head and then cluster head to the base station (Di).

Fitness=E+(N-D)+Di/N

Selection:-Selecting the nodes from the current population to generate the new population. This selection size is 3.

Crossover:- the crossover rate of 2 chromosomes is used, with specific probability rate.

Mutation:- The mutation operator is applied on each bit of the chromosome with probability rate of mutation rate. Every bit while mutation will be 1 from 0 and from 0 to 1.

VII. RESULTS AND ANALYSIS

7.1 Network Configuration

Table 1 Parameters

Parameter Name	Parameter Value
Area Along x-axis	100m
Area Along y-axis	100m
Sink position along x-axis	150m
Sink position along y-axis	50m.
Number of nodes	150(count)
Initial Energy	0.5(j)
Transmission Energy	50*0.000000001(j)
Rotations	100
Receiving Energy	50*0.000000001(j)

7.2 Performance Parameters

1. Residual Energy.
2. Dead Nodes count.
3. Alive Node Count.

Residual Energy: It is amount of energy that have been left while making the communication between source node and then to the cluster head and finally to the base station. On each occasion there will be receiving energy, transmission energy, aggregating energy etc.

Residual Energy= total initial energy - total energy consumed

Dead Nodes Count: It is the count of number of nodes that have been dead while their energy becomes zero. And their activity has been dormant.

Dead node count= total node – alive node

Alive Nodes Count: It is the count of number of nodes that have been dead while their energy becomes zero. And their activity has been dormant.

Alive node count=total node – Dead node

7.3 Results

7.3.1 Comparison of the Energy Dissipation for Kangaroo and Enhanced Kangaroo.

In Fig. 4 shows the comparison of the energy between the Kangaroo and the enhanced Kangaroo. Less energy will be required for the Enhanced Kangaroo. That means the Enhanced Kangaroo is better technique compared to the simple Kangaroo.

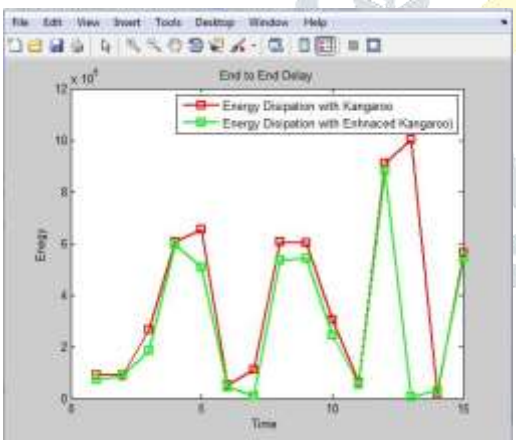

Fig. 4 Energy Dissipation comparison

7.3.2 Comparison of the Dead Nodes for Kangaroo and Enhanced Kangaroo.

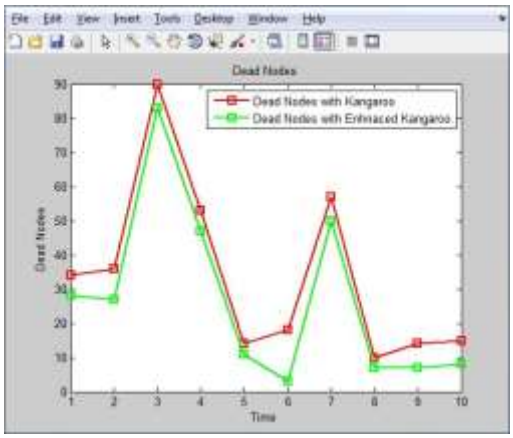

Fig. 5 Dead Node Comparison

Fig.5 shows the Dead node comparison of the Kangaroo and the Enhanced Kangaroo. Means less number of the node will be dead in whole life time of the network. So the network life time will be extended.

7.3.3 Comparison of the Alive Nodes for Kangaroo and Enhanced Kangaroo.

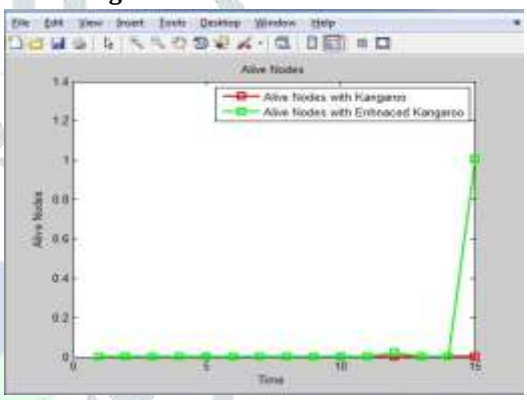

Fig.6 Alive Nodes Comparison

Fig. 6 shows the Alive Nodes Comparison between the Kangaroo and the enhanced Kangaroo. That means more number of Alive Node in case of the Enhanced Kangaroo compared to the Kangaroo based technique.

VIII. CONCLUSION

WSN is the self maintained network. In today's environment various sensor nodes are being kept at different positions in the network area. Each sensor node has to sense the data from its environment and send that to the base station. Because there is no central antenna so each node sends the data through the relay node. Node the process of both sending requires energy. For having efficient use of the energy a better route identification criteria is used. In case of Leach-Kang the hierarchical based routing is used. Where the each sensor node sends the data using cluster head and then sends to the base station. But further using fuzzy over to kangaroo will strengthen the technique further. In proposed technique the all parameters has shown the improvements. These parameters are like Residual energy, Dead Nodes Count, Alive Node etc. so the proposed technique has makes the network more efficient.

IX. FUTURE WORK

In WSN the route identification based on the optimization technique can be better technique. But in future various cluster building techniques for better cluster designing can be used for strengthening the technique further.

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