Enhancing Energy Efficiency in WSN

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Abstract - ***There is a need for wireless communication, especially in situations where traditional infrastructure communication networks do not exist. This has encouraged the appearance of the infrastructure referred to as (WSNs). WSNs are multi-hop, self-organized and decentralized networks. The dynamic nature of WSNs provides many challenges that require extensive research in order to provide a satisfying performance to their users. The usage of battery is the most important concern in a WSNS network. In this work the Energy Balancing Routing protocol (EBRP) is developed and simulated which is used to obtain the efficient use of node energy so that secure route is obtained.***

Key Words: — *Wireless Sensor networks, energy efficient routing, Sensor Nodes, Cluster Head.*

1. INTRODUCTION

The development of WSNs in wireless technology has enabled the development of low cost, low power, multifunctional sensor nodes that are in small size and communicate in small distances [2]. These tiny sensor nodes are used to sense the physical parameter and then to communicate to a remote place. One very important characteristic of this WSN is that they are application oriented. They are designed as per the requirements of applications. Individually, these sensing nodes are resource constrained and therefore are capable of limited processing and communication [9]. Location of these sensor nodes can be changed without rewiring and can be configured into different network topologies like Star, Mesh, Bus,etc.

2. EXISTING SYSTEM

In the existing system, the Sensor Networks are still in an early stage in terms of technology. Needs improvement or new routing protocol focus on energy efficient routing whose target is to find an optimal path to minimize energy consumption in whole sensor network [2]. The energy aware routing maintains multiple paths and properly chooses one for each packet delivery to improve network survivability. It may be quite costly since indeed to exchange routing information very frequently and may result in energy burden and traffic overload for the nodes [2]. For these reasons it is very important to enhance energy for routing efficiently.8

3. PROBLEM IDENTIFICATION

Energy is an important resource for a sensor node[2]. The main problem is its low battery-power. When its battery power gets off the sensor node will die. These sensor nodes are like use and throw type. Its life depends on it battery power. So it is very important in wireless sensor networks (WSN) [2] to makes energy-efficient protocol design that can handle this type of challenging problem.

4. SYSTEM DESIGN DESCRIPTION

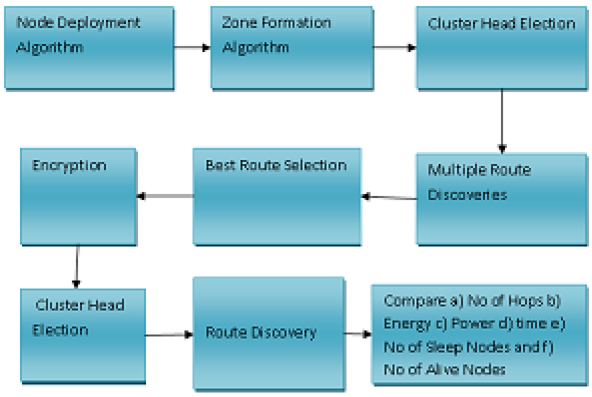

***Fig.*1** System Architecture

Figure shows the system architecture diagram for the EBRP routing algorithm.

1. Node Deployment Algorithm

This algorithm is responsible for deployment of nodes in a particular area[3].

2. Zone Formation Algorithm

Zone Formation algorithm divides the entire are into multiple zones. Each Zone having a set of nodes in its zone. This is the algorithm which is responsible for deploying the nodes. The entire area is divided into zones with each zone bounded with the limits with some xmin and xmax. The y region is bounded within the limits ymin and ymax. Each zone is allocated a set of nodes [3].

3. Cluster Head Election

This algorithm is used to elect the zone leader by computing distance value .The distance value is computed per zone for all nodes and whichever node has minimum value of distance becomes the zone leader [3].

4. Multiple Route Discovery

This is used to find multiple routes from source node to destination node [3]

5. Best Route Selection

This algorithm is responsible for selecting the best route which has the maximum Forward Factor.

6. Cluster Head

This algorithm elects the cluster head .

7. Route Discovery

The Route Discovery algorithm is used to discover the path from the source node to the destination node [10].

8. Hops Comparison

This is defined as the number of intermediate nodes between the source node to destination node [6][13]

9. Energy Comparison

This is defined as the energy consumption for transferring the control packets between the source node to destination node [12]. It is defined by the equation

$$TE_c = \sum_{i=1}^{N_l} E_c(i)$$

Where,

$$N_l = Number \ \ of \ \ Links$$

and

$$E_c = 2 * E_{tx} + E_{amp} \ \ d^{\delta}$$

$$E_{tx} = Energy \ required \ to \ transmit \ control \ p$$

$$E_{amp} = Energy \ required \ \ for \ amplification$$

$$d = distance \ between \ the \ nodes$$

$$\delta = attunuation \ \ factor$$

10. Power Comparison

This entity is used to do the power comparison between the two LEACH and EBRP algorithms. The total power consumption of the route is defined as

$$TP_c = \sum_{i=1}^{N_l} P_c(i)$$

Where,

$$N_l = Number \ \ of \ \ Links$$

and

$$Pc(i) = PowerConsumed \ across \ link \ i$$

is given by

$$P_c = \frac{P_t}{1+d^{\gamma}}$$

$$P_t = power \ required \ \ for \ transmission$$

$$d = distance \ \ between \ the \ nodes$$

$$\gamma = environment \ \ factor$$

$$0 \le \gamma \le 1$$

The environment factor values for the different environments in the WSN network are

Environment Factor	Value
Standard	0.5
Rainy	0.07
>42	0.8
<30	0.0654

11. End to End Delay or Route Discovery Time

The end to end delay is the time taken for a control packet to traverse from source node to destination node and come back [6].

$$RDT = t_{stop} \ - t_{start}$$

$$t_{stop} = Time \ at \ which \ RRPLY \ is \ recieved \ \ at \ the \ source \ node$$

$$t_{start} = Time \ \ at \ \ which \ RREQ \ is \ intiated \ at \ the \ source \ node$$

12. Sleep Nodes

This is the nodes which have not participated in routing

13. Non Sleep Nodes

These are the nodes which participated in routing.

5. EBRP (ENERGY BALANCED ROUTING PROTOCOL)

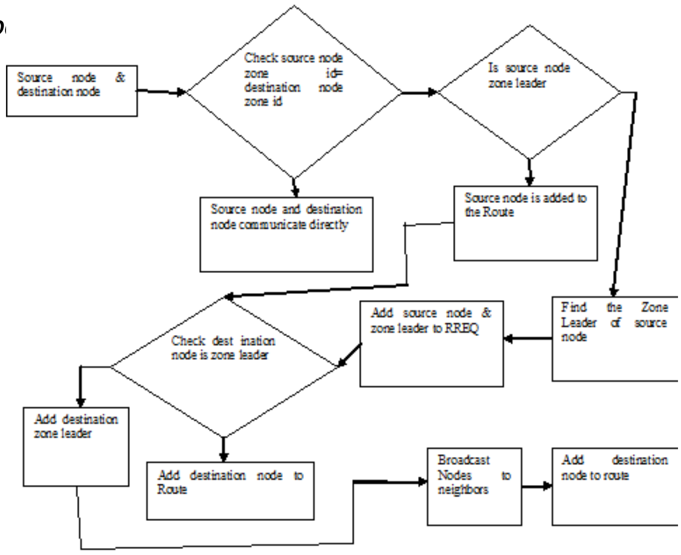

Fig.2: EBPR Routing Algorithm

Fig shows the information about route discovery process Source Node & Destination Node are inputs
Check whether the source and destination in same zone. If Yes Communication happens directly.

If Source Node & Destination Node are not in same zone. then check whether source node is zone leader. If source node is Zone Leader then add to route. Otherwise find the zone leader of the source node then add the source node to route and then zone leader of source node to route.
4. Check whether destination node is zone leader then destination node is added to route. Find the destination zone leader and add to route and then add destination node to route.

6. BEST OPTIMIZED ROUTE SELECTION:

The best optimized route is calculated by using the following formula

$$FAF = N_{hops} + D_{total} + E_{consumed}$$

Where,

N_{hops} = Number of hops from source node to destination node

D_{total} = Total Distance Computed over the route

$E_{consumed}$ = Total Energy consumed over the route

For each of the routes the FAF is calculated and the route which is having the minimum FAF is the best route. The FAF is computed is as below

$$FAF = \min\{FAF_1, FAF_2, \ldots\ldots\ldots\ldots, FAF_n\}$$

The Energy consumption over the individual link is computed as below

$$E_{tx}(l,d) = E_{tx-elec}(l) + E_{tx-amp}(l,d) = \begin{cases} lE_{elec} + l\varepsilon_{fs} d^2 & d < d_o \\ lE_{elec} + l\varepsilon_{mp} d^4 & d \geq d_o \end{cases}$$

Where, l = number of bits

E_{elec} = Amount of energy spend for sending the data

ε_{fs} = Energy Coeefcient $0 < \varepsilon_{fs} \leq 5$

ε_{mp} = Energy Coeefcient $0 < \varepsilon_{mp} \leq 3$

d = Distance between the nodes

7. COMPARISION

7.1 Energy Consumption Comparison between EBRP and LEACH

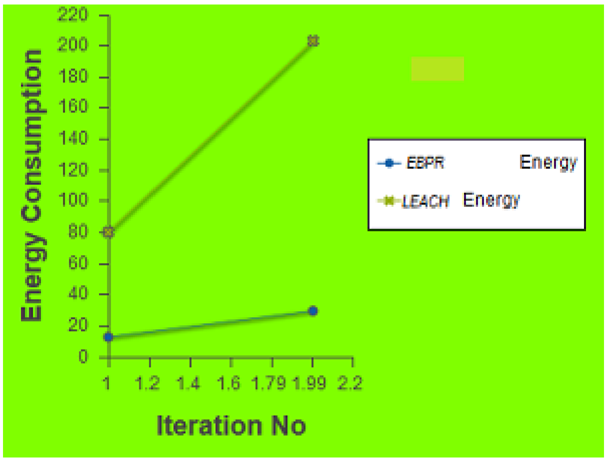

Chart1: Energy Consumption Comparison

7.2 Hops Comparison between EBRP and LEACH

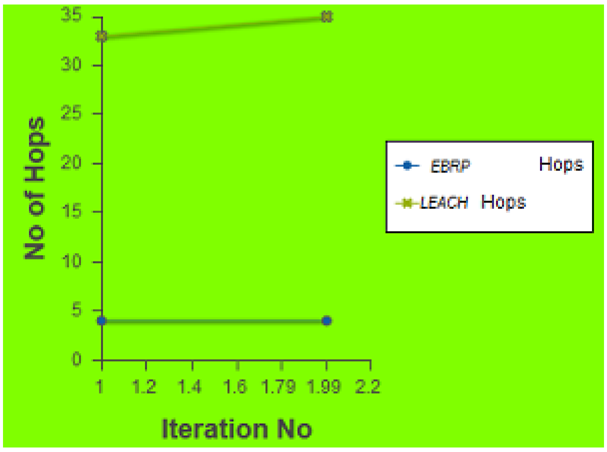

Chart2: Hops Comparison

7.3 Time Taken Comparison between EBRP and LEACH

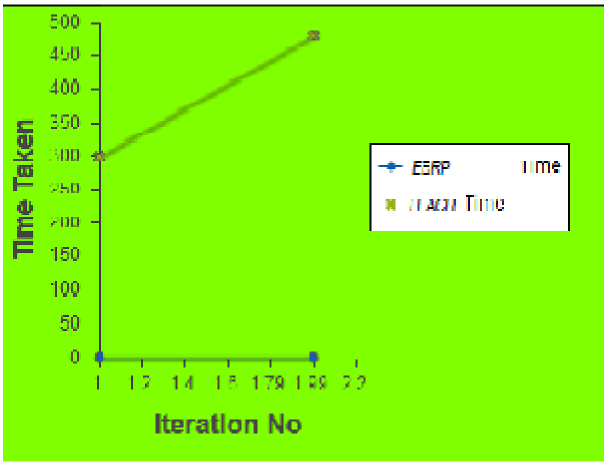

Chart3: Time Taken Comparison

7.4 No. of Sleep Nodes Comparison between EBRP and LEACH

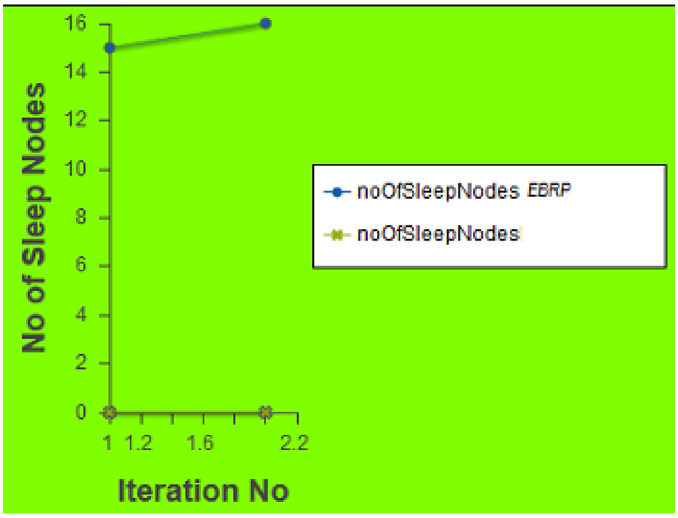

Chart4: Sleep nodes Comparison

7.5 No. of Non-Sleep Nodes Comparison between EBRP and LEACH

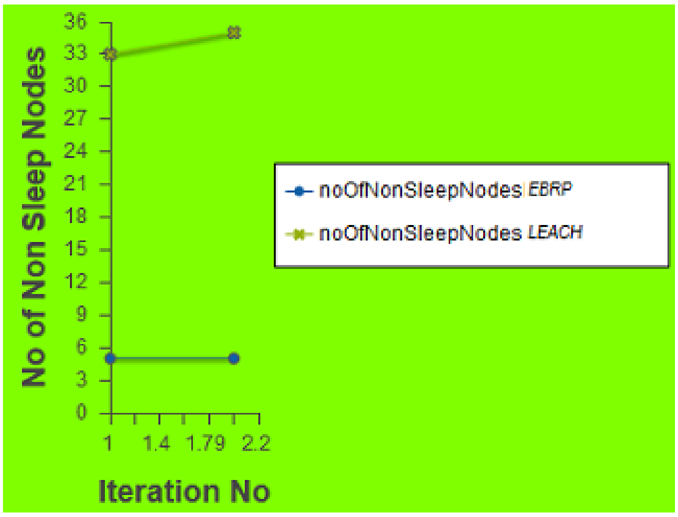

Chart5: Non-Sleep nodes comparison

8. CONCLUSION

With the above implementation it is clear that EBRP can be high energy efficient than LEACH routing when compared with energy consumption, number of hops and number of sleep nodes in Wireless Sensor Network.

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