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**INTERNATIONAL JOURNAL OF
 ADVANCED RESEARCH (IJAR)**

Article DOI: 10.21474/IJAR01/10025
 DOI URL: <http://dx.doi.org/10.21474/IJAR01/10025>



RESEARCH ARTICLE

BDRRP:BACK OFF DELAY BASED RELIABLE ROUTING PROTOCOL FOR WIRELESSEN SORNETWORK.

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Manuscript Info

Manuscript History

Received: 10 September 2019
 Final Accepted: 12 October 2019
 Published: November 2019

Key words:-

Wireless sensor networks, Reliable forwarding, Data collection, back off scheme, Routing Protocol, Energy Efficiency.

Abstract

In Wireless sensor networks, sensor nodes sense the data from environment according to its functionality and forwards to its base station. This process is called Data collection and it is done either direct or multi-hop routing. In direct routing, every sensor node directly transfers its sensed data to base station which influences the energy consumption from sensor node due to the far distance between the sensor node and base station. In multi-hop routing, the sensed data is relayed through multiple nodes to the base station, it uses less energy. This paper introduces a new mechanism for data collection and routing based on biased back off scheme. The proposed algorithm is termed as BDRRP: Back off delay Reliable Routing Protocol. This algorithm is explained and implemented using MATLAB. The performance results are compared with LEACH. The comparison reveals that the proposed algorithm performs better than LEACH.

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Introduction:-

Wireless Sensor Networks (WSNs) are extensively used in numerous real time applications such as military, medical, disaster detection, structural monitoring, etc. These WSNs contains huge set of small sensor nodes, deployed in the environment for monitoring environmental parameters such as humidity, temperature, pressure, etc. The wireless sensor nodes sense the data from environment based on the application and forwards to the central base station or sink for further processing. This process is called data collection, which is the primary task of the WSNs. In data collection process, the sensor nodes forward the data to the central base station either by direct communication or by multi-hop communication. The direct communication from sensor nodes to base station is energy expensive due the distance between sensor nodes and base station is more, this reduces the lifetime of the network. Alternatively, Multi-hop communication schemes are used for better network lifetime and performance due to its effective utilization of resources. In multi-hop communication, every sensor node is busy in forwarding the sensed/received data to nearest intermediate (neighbor) nodes or to the base station using multi-hop routing paths.

In this process, selection of next (neighbor)node in routing path is very important for forwarding data. Then next node or forwarding node in the routing path is not only meant for relaying the data, but also useful for aggregating the data. Data aggregation or Data fusion techniques are used to shrink the size of the data packet to be transmitted to next node by aggregating the data or by eliminating similar data, received from previous nodes. Multi-hop techniques improve the energy conservation of node and the lifetime of the network.

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Back Off Delay Based Reactive Routing Protocol(Bdrrp)

A reliable routing protocol, is proposed for data collection in WSN. We consider a dense multihop static WSN deployed in the sensing Fields. Since opportunistic routing is normally effective for wireless networks with higher node densities (e.g., more than ten neighbors per node), we assume that each node has plenty of neighbors. When a node has packets to send to the destination, it launches the on-demand route discovery to find a route if there is not a recent route to a destination.

The proposed BDRRP algorithm is explained in Fig.2. This algorithm consists of two stages: Initialization stage and Path Selection and Data Relay stage. These stages are explained in the section given below.

Initialization stage.

Initially, in this stage, all the sensor nodes are randomly placed in the environment depends on the application. All nodes in the network computes its hop count distance from the BS. For calculation of hop count, BS broadcasts the Beacon message containing its identity. The node, which receives the Beacon signal responds with its id and its location coordinates. BS calculate the hop count from each node using the node coordinates and send the hop count value to nodes. Each sensor node stores hop count value in Neighbor Node information table (NN table). The NN table consist of Next-Node, Hop Count between Next node and BS (HC-BS), Neighbor Node Remaining Energy (NNRE), Distance (Distance between source node and next node), and Distance from next node to BS (D-to-BS).

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1: Procedure BDRRP ( )
   //Stage I: Initialization Stage
2:   node Deployment( )
   // Stage II: Path Selection and Data Relay
3:   While (not all nodes are dead) do
4:     Repeat
5:       Forward_Node_Selection( )
6:       Forward_Data( )
7:       Update_Energy( )
8:       Update_NNtable( )
9:     Until data reaches to BS
10:  End
11. End Procedure

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Fig 2:-BDRRP Algorithm

Forward node selection.

If a node has data packets to send to a destination, it initiates a route discovery by flooding an RREQ message. When a node receives a non-duplicate RREQ, it stores the upstream node id and RREQ's sequence number for reverse route learning. Instead of rebroadcasting the RREQ immediately in existing reactive routing protocols, we introduce a biased back off scheme at the current RREQ forwarding node. The aim of this operation is to intentionally amplify the differences of RREQ's traversing delays along different paths. This operation enables the RREQ to travel faster along the preferred path according to a certain defined metric. Let and denote the last-hop node and current forwarding node of an RREQ, respectively. Let v_i and v_j denote the set of v_i 's one-hop neighbors, and $C(i, j)$ denote the common neighbor set between v_i and v_j . We define a helper v_k between v_i and v_j as the common neighbor of v_i and v_j , satisfying $P_{ik} > P_{ij}$ and $P_{kj} > P_{ij}$, where P_{ij} is the PRR between v_i and v_j . For cooperative routing, there exists an implicit constraint, that is, the nodes in the helper set should be able to hear from each other with a reasonably high probability. Let $H(i, j)$ denote the set of helpers between and. In other words, $H(i, j)$ is the common neighbor set between v_i and v_j on the premise that any two nodes in $H(i, j)$ can overhear each other, and $H(i, j), P_{ik} > P_{ij}, P_{kj} > P_{ij}$.

Let b_{ij} denote the back off delay at the current forwarding node v_j , which receives an RREQ from v_i . b_{ij} is calculated as defined in

$$b_{ij} = \frac{\text{Hopcount} \cdot \alpha}{\sum_k P_{ik} P_{kj} + 1} \quad (1)$$

where α is a time slot unit; the HopCount is the RREQ's hop distance from the source node thus far. The rationale is that, the neighbor by more forwarding candidates, better link qualities, as well as shorter hop-count will have a shorter back off delay to rebroadcast the RREQ.

Aggregate and forward the data.

Forward nodes perform data aggregation on receiving and/or sensed data and then forward to the next selected forward node towards the BS. The energy consumption for data aggregations calculated using the Equation 4

$$EF(b) = bEDA \quad (2)$$

where EDA is the energy needed for Data Fusion or Aggregation of sensor data. b is the data packet size.

Update energy of each node and NN information table.

The first order radio energy model of sensor node considered for this work is discussed in [12] is used to calculate the RE (Residual Energy) of a node i , when it transmits or receives the data packet as follows:

$$RE(i) = RE(i) - (ETX(b, d) + ERX(b, d) + EF(b)) \quad (3)$$

where $ETX(b, d)$ is the energy consumption for transmitting b bit of data in d distance. $ERX(b)$ is the energy expenditure for receiving bit of data.

Simulation Results And Analysis:-

The proposed BDRRP routing algorithm is developed and tested using the MATLAB (2012b). The algorithm is simulated using 100 sensor nodes were randomly deployed in $100m \times 100m$ area along with BS. The BS was located in (50,50) position. The transmission range (Tr) of every sensor node in one hop was fixed at 20m. The initial energy (E_0) for the sensor node was set as 0.5J. The value of Electronic amplification (E_{elec}) for transmitting and receiving the data was set as 50nJ/bit. The packet size of data was 4KB. The energy consumption of a sensor node for transmitting data using free space model (ϵ_{fs}) and multi-path model (ϵ_{mp}) were set as 10pJ/bit/m², 0.0013pJ/bit/m⁴ respectively.

Result analysis:-

In this Section the performance of proposed algorithm BDRRP protocol is analyzed and compared with LEACH protocol. For comparison important performance parameters are considered such as

1. The Numbers of nodes alive over stimulation time (rounds)
2. The numbers of nodes dead over the simulation rounds
3. The Remaining Energy over simulation rounds
4. The data packets reached to the BS over simulation rounds.

Figure 3(a) shows the graph plotted for the dead nodes over simulation rounds. The first node died earlier in BDRRP than The Other Two approaches due to multi-hop transmission of data packets. However, the last node expired earlier in existing approaches than the BDRRP. This shows the lifetime is extended in the proposed approach due to the biased back off scheme is used for selection of the next hop node. Similarly, the graph plotted for number of alive nodes over simulation rounds is shown in Fig. 3(b). Figure 4(a) shows the graph plotted for remaining energy of

each round. BDRRP consumed less energy compared to the existing algorithms. This is due to the nodes in the BDRRP forward the data to the nearest (less distance) node with less energy.

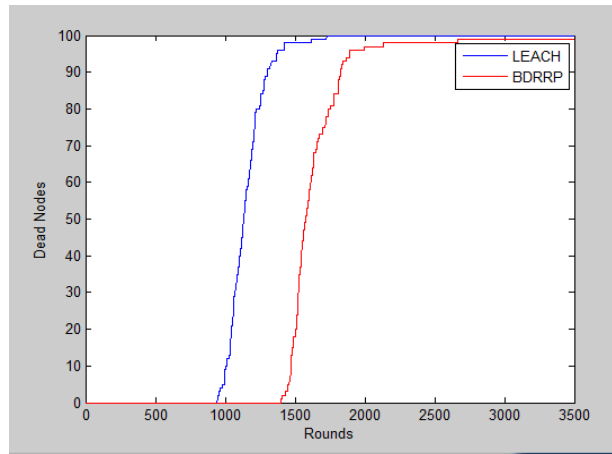


Fig 3:- (a) Dead Nodes vs Round

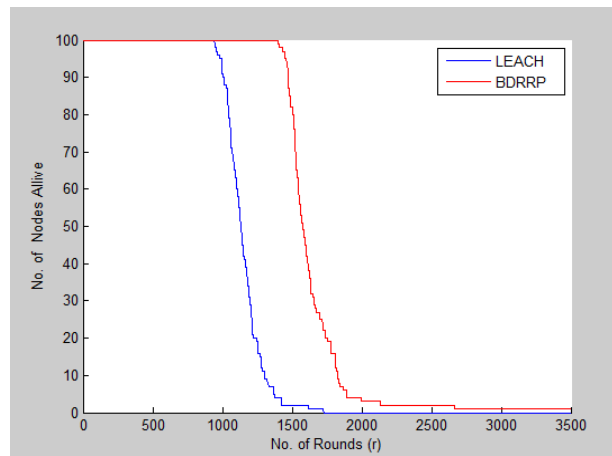


Fig 3:-(b) Alive Nodes vs Round

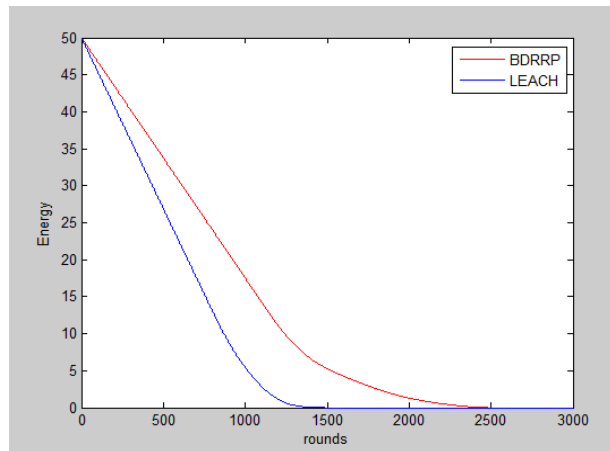


Figure 4 b:- shows the graph plotted between data packets forwarded to base station and simulation rounds. More data packets are relayed to the Base station in BDRRP when compared to the existing approach.

Conclusion:-

In WSN, Multihop routing is an effective mechanism for data collection. In multi-hop routing, the selection of forward node for relaying data plays a vital role. In this paper, biased back off scheme, is used to propose BDRRP. A BDRRP is reliable multi-hop routing protocol for data collection in WSN to conserve energy and expand the network lifetime. In BDRRP, the hop count value and PRR (packet reception ratio) is considered as parameters for forward node selection. Finally, proposed work was compared with LEACH by considering the performance metric such as network lifetime and energy consumption.

Fig 4:-(a) Remaining energy vs Round

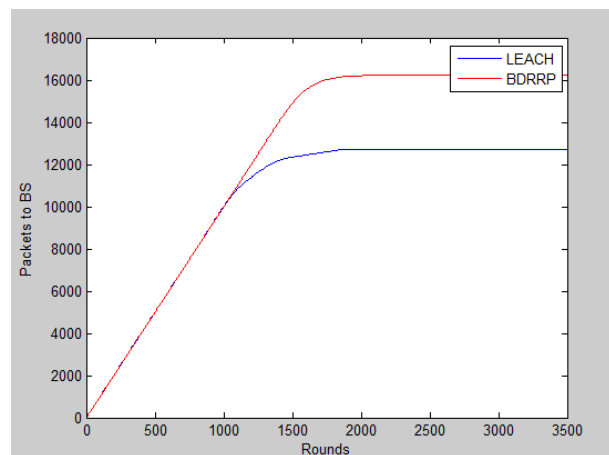
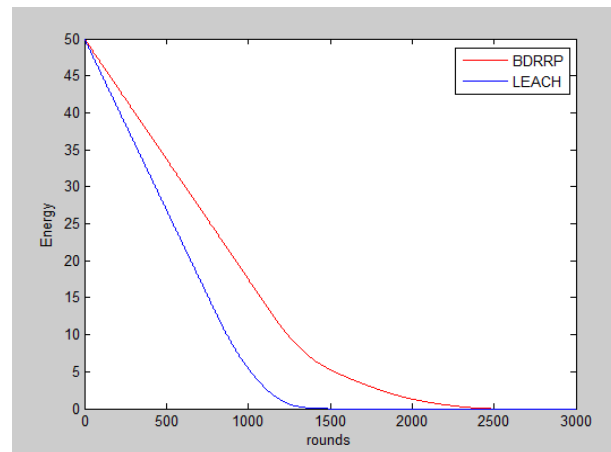


Fig 4:-(b) Number of data packets sent to BS vs Round

From the results, it is observed that BDRRP performs better than the existing algorithm.

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