Dynamic Energy Retaining nodes in Wireless Sensor Network

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Abstract

A sensor node in a wireless sensor network lost its energy and goes to dead state due to high transmission rate, high sensing interval rate, and acting as an intermediate node. Network lifetime will be minimized very quickly. To improve energy efficiency of a node in network, and to save a node from dead state, we proposed a DERN algorithm. This algorithm will saves node's energy and avoid the node's dead state. Based on the energy level, a node will change its behaviour and control its interval rate also. If energy of a node goes below a certain specified threshold level then that node will change its role from intermediate node to leaf node and adjust its interval rate. Energy level is intimated to neighbour by means of status table. Keyword: Sensor node, energy, DERN, interval rate, leaf node, neighbouring node.

DOI Number: 10.48047/nq.2022.20.19.NQ99036 **NeuroQuantology2022; 20(19):409-416**

Introduction

A sensor node in a Wireless Sensor Network (WSN) is distributed across the environment, and sensors are used to gather information about the designated area and transmit it to the sink node. The sink node or base station may provide us the information about the surrounding environment. Monitoring forest fires, monitoring habitats, monitoring military purposes, and so on are application area of sensors.

In monitoring environment, sensors will face various challenges. One of the greatest problems is the loss of energy during transmission. As a result of number of factors like retransmission, proximity to a sink, and most trusted node, some energy is being squandered. Several algorithms and models are developed to overcome the energy consumption issue[8][9].

Generally sensors are built up with memory, processing unit, transmission unit and sensing unit. The Sensor Sensing Interval Rate (SSI) is computed in the sensing unit using the data collected by the sensor while it is in use. Transmission unit is used to transmit the information i.e, the collected information of the sensors. This unit is used to calculate Sensor Sending Interval (SDI) rate.

Memory will store some data like, if it takes time to transmit the sensed information in that time it stores the data inside it. The memory capacity of the node is also very low. Processing unit is used to manipulate the information or any it will manipulate a control information. Checking the energy level and compared with the threshold level of the whole network will be processed in this paper. Energy is the one of the important aspect which reduces the lifetime of a network.[8] Indicating that a sensor is questionable and disseminating this information to all other nodes in the network is proposed in a status table. We use a status table for to spread the information about the current node.

2. Related work

To send a message to the sink node with the least amount of delay and the highest amount of energy, the energy factor and time delay factor functions are implemented [1]. In order to save energy, [2] developed an Energy Consumption (ECON) model, which filters out messages that are sent frequently. Clustered networks benefit from this design. Additionally, the network's life span will be extended as well. [3] Handheld devices using DPSKOFDM can send very large amounts of data in a safe and effective manner through DWT barcode modulation.

[4] Proposed a novel paradigm that resolves the conflict between WSN service quality and long-term viability. An approach known as SFLA lowers the signal's long-term dependency on a model. [5] Segment equalisation clustering based on Cluster head energy consumption (SECHEC) is a novel clustering technique that has been proposed. SECHEC efficiently enhances network lifetime and ensures system availability throughout its lifecycle.

[6] WSN power consumption may be evaluated using a new method presented. WSN apps' power consumption may be measured using the programming language code they wrote. To increase the node's energy level, a new quick response code has been proposed. Each message is created with a unique QR code because of the repetition of the same content. During transmission, same QR code found then it will not be transmitted [7] .[8] Developed a status table to alert other nodes in the network that a certain sensor is suspicious and to disseminate this information to the whole network.

[9] Proposed a model for energy consumption node in a network. Model is based on event trigger mechanism which analyse energy status of nodes. [10] Proposed a theorem which optimize the hop lengths and a routing algorithm to improve the WSN power consumption. The theorem check optimal hop length and minimum level of energy consumption. It creates shortest path to route packet, hence it improves energy level and network lifetime also increases.

[11] Proposed algorithm which avoids least energy node and maintain low energy consumption.Low Cost Minimum Max Energy routing algorithm LCMMER and it is compared with MTPR and MMBCR. Finally, proposed algorithm selects the route having maximum energy with its least cost node.

One of the factors for energy loss, energy is used to select the route between two nodes. It considers not only residual energy of each node but also the transmission cost for this route.

[12] Proposed a method to detect the energy consumption node in network using oscilloscope which stream digitized voltages into a PC, which calculates the profile of energy consumption. [13] In clustering architecture, cluster head will dead soon due to its energy lost, it can be detected and solved by proposing an algorithm called (SECHEC)

3 Proposed work

Energy consumption of node is an important issue in Wireless sensor networks. Due to energy loss, a sensor node will going to dead state it will not participate in packet forwarding.

Dynamic node

We analysed, in a flat routing structure, most of the intermediate node lost its energy by forwarding the message from one node to another node. Node closer to base station also lost its energy quickly. Comparatively an intermediate node will lost its energy at very minimum amount of time than leaf node. Leaf node will monitor the environment and forward the message to base station, it will not participate in any packet routing.

In this paper, we propose based on the energy, node will change their behaviour automatically and save its energy. The energy of intermediate nodes and those that are near to the sink nodes will be swiftly lost. Hence each node has a threshold level if the energy reaches that level it goes to intermediate node into leaf node. Change of mode from intermediate to leaf node will be informed to other nodes in the network by means of status table. A node will change from intermediate mode to leaf mode is called as dynamic node.

Based on the work allotted to the network, threshold level will vary from one network to another network. Threshold level is calculated based on the energy level of nodes in network, and work allotted to the network. Value of Send interval and value of sense interval will also be changed based on the threshold. Send interval means sending data interval. Sense interval means monitoring data and capturing data from the environment.

3.1 Send Interval SDI and Sensing Interval SSI

Intervals between data packets may be defined by the user by send interval feature. Periodically if a sensor is sensing the environment and forwarding the message will not lost energy when compared to event driven.

Event driven sensors will monitor and it keep on sending the information ,if event occurs simultaneously.in this situation energy will be lost quickly. To avoid this, we proposed SDI and SSI

SDI means sending interval, time required to send collected data. SSI means Sensing interval, time required for sensing the environment. There are four parameters for sending interval and sensing interval. Both the intervals are high means sending and sensing time limit should be within seconds. Energy will drain quickly. Both the intervals are low means sending and sensing time limit should be an hour. If

the sending interval value is medium means it depends on the sensing interval. When both the intervals are low then time limit should be within an hour. It can increase or sustain the energy level of a node. But it cannot send precise information. Only the SDI and SSI of a node will change if the node's energy level falls below the threshold.

Less data will be obtained if the sense interval clause is set high, resulting in less precise findings. It is possible that a big sample will provide a more accurate result because of the clause's relatively low value. The sensor node will use more power in this circumstance. The transmit interval clause's value should be precisely specified as well. It affects the amount of memory you have available. There is an increased risk of a sensor node running out of memory if its value is high.

Data traffic and energy usage both rise when the bit rate is kept low. The trade-off between energy consumption and query accuracy occurs because of the direct impact that transmit interval and sense interval have on network performance and sensor lifespan. A node may be rescued from a dead state by altering the values of the transmit and sense intervals. Overall network lifetime also increased.

Table-1 Mode and interval value of energy losing node before DERN

Node-id	**Mode**	**Energy value**	**Sending Interval(SDI)**	**Sense Interval(SSI)**
N1	Leaf node	75%	5 depend	6 low
N2	Intermediate node	66%	4	7
N3	Leaf node	80%	4.5	8
N4	Intermediate node	36%	3.5 depend	3.5 low
N5	Leaf node	89%	5.8	8
N6	Intermediate node	58%	6	6.5

Threshold energy level is 40% means if a node reaches of energy level, the role of the node will be changed from intermediate to leaf node. And the value of the sending interval is minimized and sensing interval also minimised. In the above table it is clearly depicted that there are six sensors which is named as (N1,N2….N6).

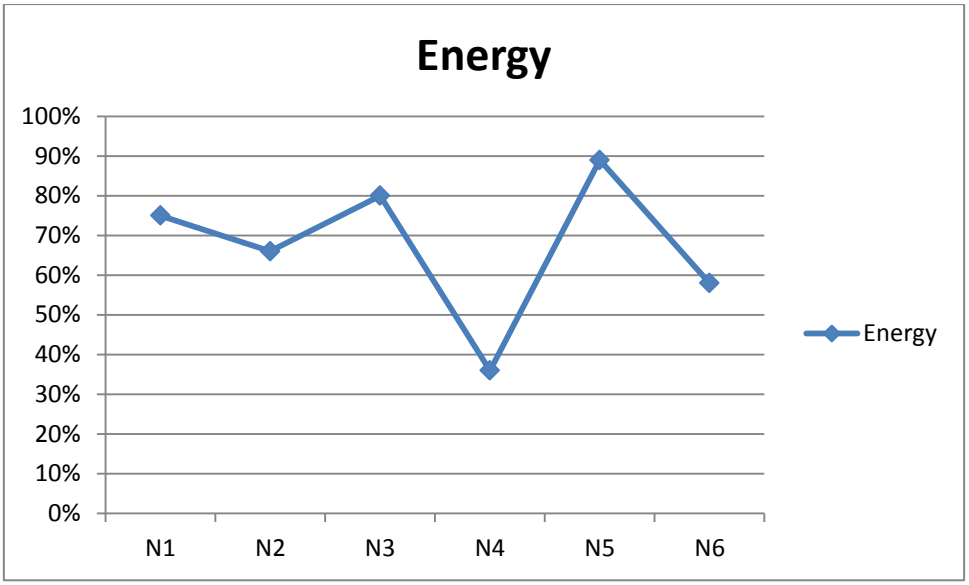

Figure-1 Energy level of a node before DERN

3.2 Mode interchanging

Mode means the role of each node in the network. Generally there are two type of node one is leaf node and another one is intermediate node.

The leaf node collects data from the environment and sends it to the forwarding node, which processes the data. Node in the chain. As a transceiver, it is an intermediate node in the network. One of the neighbouring nodes may exchange data with it. As a result, the intermediate node in the network used up a lot more energy than the leaf node.

Based on the energy level, a node can change its behaviour from leaf node to intermediate node and vice versa. Leaf node mode is activated when a node's energy value is close to 40%; at the same time, the intermediate node mode is activated when an anode's energy value is 50% to 60% of the leaf node value. After converting their role into a leaf node, it will participate in packet routing but it will not act as a transceiver. It will reduce the energy consumption.

Dynamic Energy Retaining NodeAlgorithm (DERN)

For n no of Nodes
Node's energy ni (E);
SDI=high; SSI=high;
Mode=intermediate;
Threshold value=di;
If ni(E)>di then
SDI=high; SSI=high;
Mode=intermediate;
Update status table
Else If ni(E)=di then
SDI=depend; SSI=low;
elseIf ni(E)< di then
Mode=leaf;
SDI=low; SSI= low;
Update status table;
End if
End if
End if.
end

In the above algorithm, it is depicted that n is the number of nodes, initially SDI,SSI values are high, mode of the node is intermediate, intermediate means a node will be a transceiver, it can send and

receive the information from the neighbouring node. Threshold value is di It is possible for a node to become a leaf node if its energy value falls below the threshold. The SDI and SSI values will be reduced. Our algorithm will reduce energy consumption of a node. Sending interval and sensing interval value will also be changed based on their energy level. It is illustrated that our algorithm will work efficiently and node's energy level.

Table-2 Mode and interval value of energy losing node after DERN

Node-id	Mode	Energy value	Sending interval(SDI)	Sense Interval(SSI)
N1	intermediate node	75%	5(high)	6(high)
N2	Intermediate node	66%	4	7
N3	Leaf node	80%	4.5	8
N4	Leaf node	36%	2(low)	2(low)
N5	Leaf node	89%	5.8	8
N6	Intermediate node	58%	6	6.5

Node n6 which suffers from the energy consumption problem, above figure depict the energy level of each node before RICA. Node n6 is act as an intermediate node, SDI and SSI Values are also high, it is predicted that this node energy level is lower than the threshold level then our RICA will change the mode of the node and changed the interval of sending and sensing time also i.e., SDI and SSI. To avoid a node entering into "disease mode," our algorithm does not enhance its energy level. It also increases the network lifetime also.

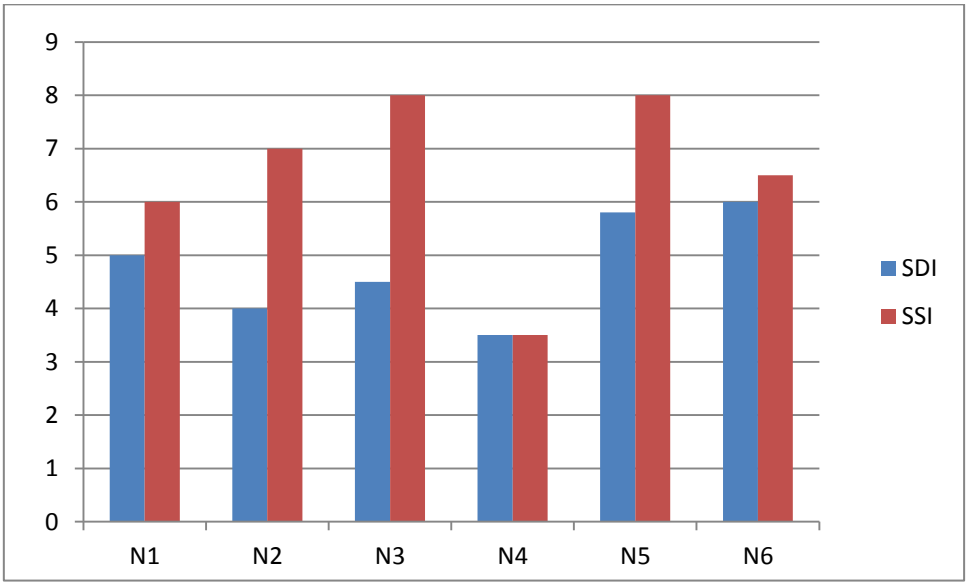

Figure-2 Sending Interval and Sensing Interval before DERN

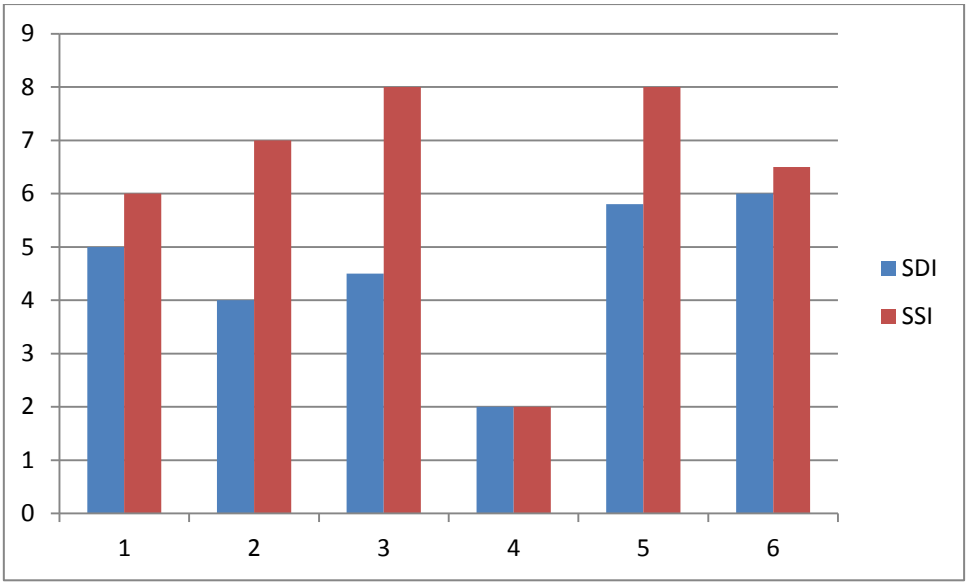

Figure-3 Sending Interval and Sensing Interval after DERN

4 Conclusions

Dynamic Energy retaining node (DERN) reduces energy consumption of a node by changing the node mode and changing the interval time of dead state node. Although a node's energy level isn't increased, the network's overall lifespan is extended as a result of the reduced energy use. This algorithm can be applied in flat and also cluster architecture. It follows RICA algorithm but here we changed the parameter, it works 25% increases network lifetime compared with RICA.

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