Improved Energy Harvesting Routing Technique for WSN

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Abstract

In wireless sensor networks, the sensor nodes are deployed in areas like hills, or under water to monitor certain conditions where human approach is bit difficult. These nodes are generally required to send the sensed data to the base station or the sink node. The nodes, which are, deployed near the sink node relay much more data than the other nodes. The result is that these nodes drain out energy more quickly than other nodes and die out soon. This creates energy hole in the network. This paper represents energy harvesting scheme that allows the nodes (running out of battery) to quickly shift the path containing high-energy nodes. The proposed technique selects the nodes based on high priority decided by number of neighbors, remaining energy, and distance to the base station. The proposed scheme shows improvement in terms of amount of energy harvested, delay, throughput and routing overhead.

Keywords: *network lifetime, energy harvesting, throughput, routing overhead*

I. INTRODUCTION

In wireless sensor networks, the sensor nodes are deployed in areas like hills, or under water to monitor certain conditions where human approach is bit difficult. These nodes are generally required to send the sensed data to the base station or the sink node. The nodes, which are, deployed near the sink node relay much more data than the other nodes. The result is that these nodes drain out energy more quickly than othernodes and die out soon. This creates energy hole in the network. Since conserving the energy of the nodes in wireless sensor networks has been given much importance in the past due to fact that replacing the dead nodes is costly affair, so the researchers have come forward with the concept of rechargeable nodes. Thus, recent times has seen a shift from energy reduction to energy harvesting techniques. Both these schemes need to go hand in hand so that network lifetime can be increased. The sensor nodes' hardware architecture needs to be changed so that energy from one form can be harvested into another. For example, sensor nodes can harvest the solar energy, or wind energy etc. This paper represents energy harvesting scheme that allows the nodes (running out of battery) to quickly shift the path containing high-energy nodes. The technique selects the nodes based on high priority decided by number of neighbors, remaining energy, and distance to the base station.Section II presents brief study about energy harvesting schemes in WSN, with proposed work presented in section III. Finally, the results are presented in section IV with the conclusion discussed at the last.

II. LITERATURE REVIEW

Shancymol Sojan et. al.,[2016] This paper talks about energy harvesting or energy searching as an efficient way to deal with the energy needs of versatile devices. A correlation of different encompassing hotspots for harvesting energy is done and an understanding into a few applications in view of this idea is made. Additionally examined are a few changes to the current harvesting design in which the determination of the source is considered as critical criteria in planning the energy collector. This idea can be used to create variable yields to power energy necessities of the different frameworks.

Noor Zaman [2016] In this paper, a cross layer design system was received to design an energy efficient routing protocol entitled "Position Responsive Routing Protocol" (PRRP). PRRP is designed to limit energy expended in every node by (1) diminishing the measure of time in which a sensor node is in a sit out of gear listening state and (2) lessening the normal correspondence remove over the system. The execution of the proposed PRRP was fundamentally assessed with regards to network lifetime, throughput, and energy utilization of the system per singular premise and per information packet basis. The exploration results were examined and benchmarked against the notable LEACH and CELRP protocols. The results demonstrate a noteworthy change in the WSN as far as energy effectiveness and the general execution of WSN.

Minkyu Chun et. al., [2016] Author has proposed low complexity rerouting plan to bypass the low energy node. The nodes close to the base station have high load to relay the information of the nodes that are found far from the sink node. Therefore, if these nodes go dead then information correspondence can get hindered in the system. Subsequently the creators have proposed a rerouting plan to bypass the low energy node in the system where the past node picks neighbor node to bypass the low energy node in the network.

Amjad and Abu-Baker [2016] This paper explores the energy efficient routing in cluster based WSN by utilizing a straight definition for issue of limiting energy utilization in such system. This plan considers energy utilization at various sensor nodes inside cluster and together improve at various sensor nodes to transmit information through course with least energy. Extensive reproduction is led to assess proposed definition.

A. Arockia Faustine et. al., [2015] In this paper, author offer a review on some normal energy gathering innovations of remote sensor networks, and accordingly the presentation of energy management innovation. The created sensor framework exploitation soil energy will be furthermore utilized for remote field analyze what's more, natural perception in an energy-compelled space and stay away from regular battery substitution. To upgrade the yield energy of a dirt cell, courteous microorganism and prepared soil substrate will be utilized.

Junaid Ahmed Khan et. al, [2014] This overview shows an abnormal state scientific categorization of energy management in WSNs. They break down different battery-driven energy utilization based plans and energy harvesting based energy arrangement plans. They additionally highlight the current achievement of remote energy transference to a sensor node as an other option to run of the mill batteries. They prescribe to consider late energy provisioning headways in parallel with the customary energy protection approaches for a sensor network while planning energy efficient plans. A few battery-driven energy preservation plans are proposed to guarantee energy efficient network operation.

Amir Ehsani Zonouz. et. al. [2014] it is basic to have a dependable routing protocol for this author first model the reliability of two distinct types of sensor nodes: 1) energy harvesting sensor nodes and 2) battery-powered sensor nodes. They then present remote connection dependability models for each sort of sensor nodes, where impacts of various parameters, for example, battery lifetime, shadowing and area instability, are considered for examining the remote connection dependability. In view of the sensor node and remote connection dependability models, they analyze the execution of various routing calculations regarding end-to-end path reliability and number of hops. In this work, they displayed the reliability of two unique types of sensor nodes: energy harvesting sensor nodes (EHSNs) and battery powered sensor nodes (BPSNs). They exhibited remote interface disappointment models for each sort of sensor nodes. In view of the node and connection reliability models, they looked at execution of various routing protocols including D, H, R, RH, and WH as far as the normal end-to-end path reliability. An element routing approach that incorporates the two best execution routing calculations R and RH was additionally proposed. Another cost capacity was likewise characterized to encourage a reasonable and exhaustive examination among these routing algorithms.

Sheenu et al., [2013] proposed method, which investigates the change of initial energy in leach protocol to prolong the network lifetime in order to achieve network reliability and scalability. On increasing the initial energy of nodes within samenetwork grid, the network lifetime increases because of nodes consuming less energy.

Rathna. R et. al., [2012] proposed paper about the remote sensor organize in natural observing applications. The sensor information in this application might be light power, temperature, weight, stickiness and their varieties. Clustering and routing are the two ranges, which are given more consideration in this paper.

Ya Yang et. al., [2012] tentatively show the principal utilization of pyroelectric ZnO nanowire clusters for changing over warmth energy into power. The coupling of the pyroelectric and semiconducting properties in ZnO makes a polarization electric field and charge partition along the ZnO nanowire accordingly of the time-subordinate change in temperature. The created Nano-generator has a decent steadiness, and the trademark coefficient of warmth stream change into power is assessed to be ∼0.05−0.08 Vm2/W. Their review has the capability of utilizing pyroelectric nanowires to change over wasted energy into power for driving Nano-devices.

III. RESEARCH METHODOLOGY

When the source node has to find a route to destination node, the process of finding the route will be modified according to the following points:

In the proposed scheme, the source node would select the high priority one hop neighbor node. The priority for any node will be defined by its remaining energy, number of neighbors and distance. If any node has highest remaining energy, more number of neighbors and lowest distance to the destination, then it would be considered as the highest priority node. Therefore, the source node would select path-having nodes with highest priority.

The number of neighbors is considered while deciding the priority for the node selection. This is because, if any node's energy goes below the threshold value then its neighboring node can be considered for sending the data as an alternative. This step will ensure that along the entire path, every node has more than one neighbor available for transferring the data to the destination.

In a scenario, if any node has remaining energy going lower than the threshold value, it can inform to the source node all the way via its predecessor node. Now the source node can shift the data traffic to the other path (which will be formed by considering the neighbors of the nodes in the first path). Meanwhile, the nodes having lesser energy in the first path can harvest their energy and recharge their batteries again.

IV. IMPLEMENTATION & RESULTS

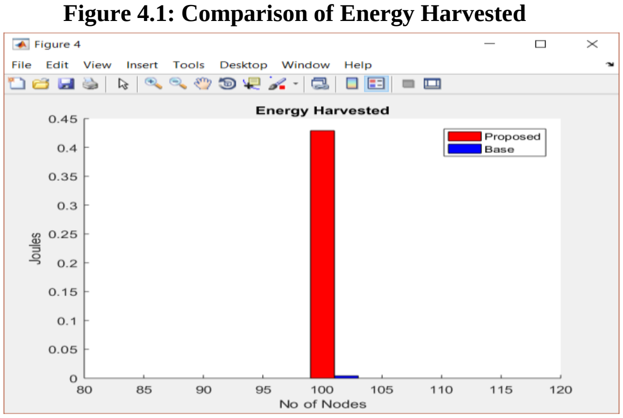
The proposed scheme as well as existing scheme [Minkyu Chun et. al] was implemented in MATLAB 2016b. The simulation parameters for setting up a network has been given in the table below:

PARAMETER	VALUE
Environment	C language
Network Aarea	100m*100m
Number of sensors	100
Initial Energy	0.9 joule
Threshold value	0.1 joule
Routing Protocol	GPS based routing

Table 4.1: Simulation Parameters

The performance of the network was measured based on amount of energy harvested, delay, throughput and routing overhead.

Figure 4.1: Comparison of Energy Harvested



The above graph shows the amount of energy harvested by nodes in both the schemes. The amount of energy harvested for the proposed scheme is much higher than the value obtained for the existing scheme, the reason to this is attributed to the fact that the entire path goes for energy harvesting in the proposed scheme. Whilst, on the other hand only a single node whose energy has been depleted goes for energy harvesting in the existing scheme. The nodes harvested a total of .4291 joules of energy in the proposed scheme and .0041 joules of energy in the existing scheme.

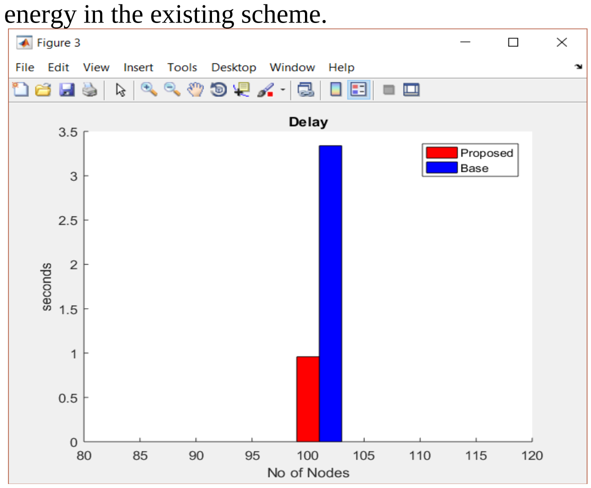


Figure 4.2: Comparison of Delay

This graph shows delay in seconds that is encountered in the network when the nodes deplete their power to change the data transmission over alternate path. The proposed scheme allows the node to unicast the power depletion message. Where as in the existing scheme the nodes broadcast the same message in the entire neighborhood. Thus, the delay is much higher for the existing scheme. The value of delay for the existing scheme is 3.33 seconds and .96 for proposed scheme.

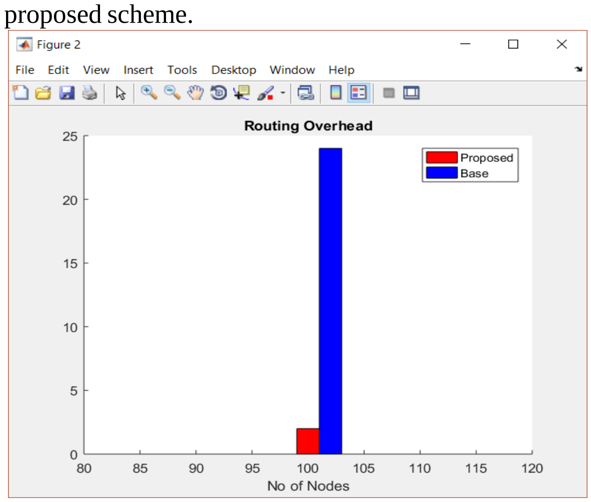


Figure 4.3: Comparison of Routing Overhead

The routing overhead is encountered when the nodes send control messages sent in the network. The broadcasting of power depletion message in the existing scheme leads to higher value of routing overhead. Where as unicasting in the proposed scheme leads to lesser value. The value of routing overhead for the existing scheme is 24 and the proposed scheme is 2.

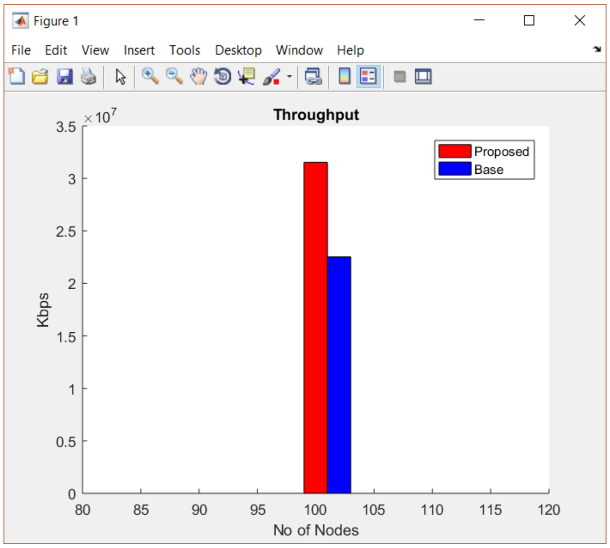


Figure 4.4: Comparison of throughput

Throughput is defined as amount of data received at destination node per unit of time. The value for throughput is higher for proposed scheme because the nodes harvest more amount of energy and can send data for longer duration of time. The value of throughput for the proposed scheme is 31539 Kbps and is 22528 Kbps for the existing scheme.

V. CONCLUSION AND FUTURE WORK

The proposed scheme as well as existing scheme was implemented in MATLAB 2016b. The work focuses on improving the amount of energy harvested in the network. The optimized route formation has been described in the proposed scheme. The source node chooses the path based on three parameters, Remaining energy, Neighbor count and distance to the destination node. The node must have highest remaining energy and highest neighbor count, it must have least distance to sink or destination node. The performance of the network was compared based on amount of energy harvested, throughput, delay and routing overhead. The proposed scheme allows the nodes (which have depleted their power) to unicast the packets than broadcasting in the existing scheme. Secondly, the source node shifts data transfer from the first path to the second path in the proposed scheme, whereas the single node (which has depleted its battery) finds the alternative neighbor to continue the data transmission. Since all the parameters showed an improved performance of the network using proposed scheme, we can conclude that proposed scheme is better than existing scheme. In this study, we have used solar harvesting technique for the sensor nodes. In future, other energy harvesting techniques can also be used to analyze their effectiveness.

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