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Energy Efficient Mid Position Opportunistic Routing for Wireless Sensor Networks

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ABSTRACT

To accomplish a high throughput in problematic wireless connections, Opportunistic Routing (OR) team up all the sensor nodes in the way while sending the data packets. In this paper, Energy Efficient Mid position Opportunistic Routing (EEMOR) has been proposed for energy efficient multi-hop communication between a source and destination pair in WSN. The source node selects the mid position node with high residual energy node as a forwarder node to transmits the packet to the destination. The proposed algorithm is implemented and evaluated. The simulation results show that the proposed algorithm performs superior to the other existing algorithms in terms of end-to-end delay, energy consumption and network lifetime.

Keywords: Energy Efficient, Network Lifetime, Opportunistic Routing, Wireless Sensor Networks

I. INTRODUCTION

Energy saving optimization becomes one of the major concerns in the Wireless Sensor Network (WSN) routing protocol design, due to the fact that most sensor nodes are equipped with the limited non rechargeable battery power. In WSNs, thousands of physically embedded sensor nodes are distributed in possibly harsh terrain and in most applications, it is impossible to replenish energy via replacing batteries. In order to cooperatively monitor physical or environmental conditions, the main task of sensor nodes is to collect and transmit data. It is well known that transmitting data consumes much more energy than collecting data. To improve the energy efficiency for transmitting data, most of the existing energy-efficient routing protocols attempt to find the minimum energy path between a source and a sink to achieve optimal energy consumption. To achieve a high throughput in unreliable wireless links, Opportunistic Routing (OR) collaborate all the sensor nodes in the path while forwarding the data packets. Also, we can classify the routing protocols into Flat based, Cluster based and Location based routing protocols on the basis of architecture. In opportunistic routing, source creates the neighbour table and chooses the best node for creating the forwarder table. Then it applies priority based on factors like energy level and distance to select forwarder from the forwarder table. In wireless sensor networks, there is a trade-off between the End-to-End delay and Network's Lifetime when we use the concept of dynamic energy consumption. MDOR has been proposed for optimizing the End-to-End delay in the transmission of information between the pairs of source and destination and networks lifetime in a wireless sensor networks.

To overcome these issues of isolated nodes, in this paper, we propose a novel approach for opportunistic routing called Energy Efficient Mid position Opportunistic Routing (EEMOR) for conserving a lot of energy. EEMOR has been proposed for optimizing the End-to-End delay in the transmission of information between the pairs of source and destination and networks lifetime in a wireless sensor networks.

The rest of this paper is organized as follows: In the next section, the research work carried out related to the proposed approach is briefly explained. In section 3, our proposed work is explained in detail. In section 4, evaluation of the proposed work and the detailed evaluation results and discussions are given. Finally, we concluded the paper in section 5.

II. METHODS AND MATERIAL

A. Literature Survey

Many works carried out by the researchers on routing in wireless sensor networks are in the literature [5-8] [9]. Luo et al [1] proposed an opportunistic routing algorithm for relay node selection called Energy Saving via Opportunistic Routing (ENS_OR) to ensure minimum power cost during data relay and protect the nodes with relatively low residual energy. In their work, the relay nodes are selected based on the optimal transmission distance for energy saving. Mao et al [2] proposed an Energy Efficient Opportunistic Routing (EEOR) to improve the network throughput. They focussed on selecting and organizing forwarder list to minimize the energy utilization of all nodes. In their algorithm, the nodes closer to the destination are selected in a forwarder list. Authors in [4], proposed an algorithm called Multi-hop Optimal Position based Opportunistic Routing (MOOR) to enhance the network lifetime. Their algorithm chooses the path with least distance and number of hops from the source and destination for transmission of data in the network.

Sharma and Singh [3] proposed Middle Position Dynamic Energy Opportunistic Routing (MDOR) algorithm for efficient multi-hop communication between source and destination. Their algorithm chooses any middle node between source and destination.

In above all these works, some works concentrated on forwarded list and some on energy saving but not both. In this paper, an algorithm called EEMOR has been proposed which concentrates both the forwarded list and energy efficiency.

B. Proposed Work

In this work, we proposed a novel opportunistic routing technique called Energy Efficient Mid position Opportunistic Routing (EEMOR). The proposed technique chooses the node which is neither close to the source nor to the destination. The node in between the source and destination is selected by storing all the nodes according to the increasing distance from the source in the forwarder list. After making the forwarder list the middle nodes from the forwarder list are selected and from this selected list the node with the maximum residual energy is chosen as a forwarder node. The process of choosing the forwarder node and forwarding the packet continues until the target node is reached.

Each node in the network maintains a list of neighbours and the nodes identify their neighbours by broadcasting a hello packet in the networks. Each sensor node including the broadcasts a hello packet to create their own routing table. Once the routing table is created, source node chooses a forwarder node which has maximum residual energy and neither close to source nor destination and ensures that the packet reaches the destination. When the packet reaches the sink node, it sends an acknowledgement to the source node. Hello packets are broadcasted at regular intervals of time to update the routing table of the sensor nodes.

Energy Efficient Mid position Opportunistic Routing Algorithm

Step 1: Source node S generates the neighbour list NL.
Step 2: List is arranged according to the distance.
Step 3: If destination node D is in NL
Step 4: Send the packet to the D
Step 5: Else select the middle nodes from the NL as forwarder list FL.
Step 6: Select the node with maximum residual energy node (FN) from the FL.
Step 7: If FN is the destination node D then send the packets to FN
Step 8: Otherwise, repeat the steps 1 to 7 until D is reached.

The main objective of this proposed work is to extend the lifetime of the network and to minimize the end-to-end delay. To improve the lifetime, in this work the residual energy is considered for selecting the forwarder node transmits its data to the sink based on the residual energy.

III. RESULTS AND DISCUSSION

The proposed EEMOR algorithm has been implemented using NS2. In this system, sensor nodes are randomly deployed over the given network area and the simulation parameters are given in Table 1. The proposed algorithm has been tested algorithm extensively and the experimental results are presented. The performance of the proposed algorithm is compared with MDOR and EEOR algorithm.

TABLE I FONT SIZES FOR PAPERS

Parameter	Value
Area	100x100 m^2
Sensor Nodes	100
Initial energy	2J
Eelec	50 nJ/bit
ε_{fs}	10 pJ/bit/m2
ε_{mp}	0.0013pJ/bit/m4
Packet size	1000 bits

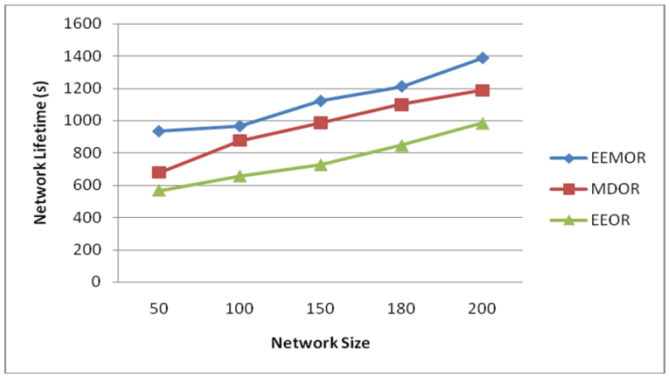

Figure 1 : Network Lifetime over Number of nodes

Network's Lifetime is defined as the time when the first node dies out of energy. This is because when a node dies, a networks partition or an isolated area may occur quickly afterwards. In Fig.1, the network lifetime over various numbers of nodes is presented. It is clear from the figure that the proposed work gives better system lifetime than the other existing algorithms. This is because for selecting the forwarder node the average distance between the source and destination and the energy of the nodes are considered.

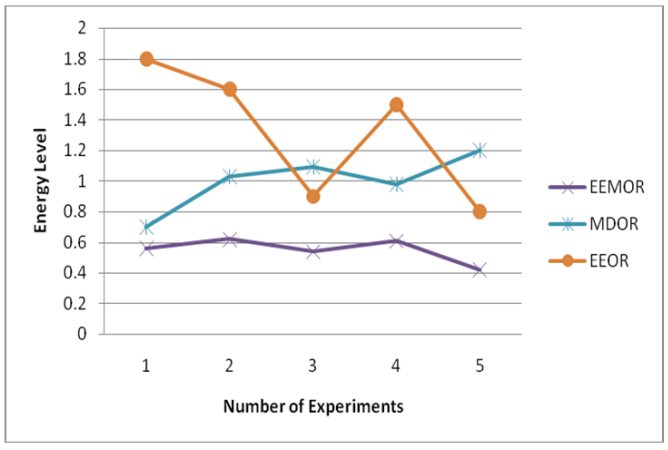

Figure 2 : The variance of Energy level

Fig. 2 presents the variance of the energy level for different experiments. From the figure it is observed that the proposed work conserves much energy and have very low variance when compared to other algorithms.

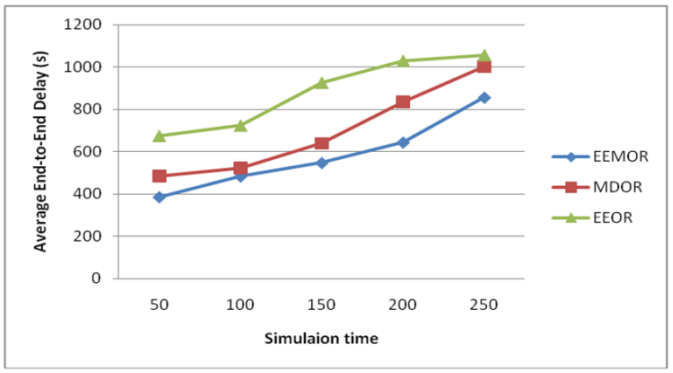

Figure 3 : Average End-to-End Delay over Simulation Time

The time passed between the source node sending the packet and the destination node receiving the packet is characterized as End-to-End delay. The number of the network simulation is varied from 50 runs to 250 runs in steps of 50 runs without changing any of the network parameters and the corresponding average End-to- End delay is plotted in Fig. 3. The plot demonstrates that proposed algorithm gives preferable execution over the EEOR and MDOR protocols.

IV. CONCLUSION

In this paper, we proposed a new protocol for opportunistic routing called Energy Efficient Mid position Opportunistic Routing (EEMOR). The source node selects the forwarder node which is neither close to the source nor to the destination and also with maximum residual energy. The proposed algorithm is evaluated using NS2. From the simulation results, the performance of the proposed algorithm is examined with EEOR and MDOR. The results show that the proposed algorithm performs better than the other algorithms in terms of end to end delay, energy consumption and system lifetime.

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