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A Relay Node Based Route Discovery Algorithm with High Network Lifetime

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Abstract: Energy savings 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 this paper, we focus on minimizing energy consumption and maximizing network lifetime for data relay in one-dimensional (1-D) queue network. Following the principle of opportunistic routing theory, multihop relay decision to optimize the network energy efficiency is made based on the differences among sensor nodes, in terms of both their distance to sink and the residual energy of each other. Specifically, an Energy Saving via Opportunistic Routing (ENS_OR) algorithm is designed to ensure minimum power cost during data relay and protect the nodes with relatively low residual energy.

Keywords: Wireless Sensor network, Energy efficiency, one dimensional (1-D) queuenetwork, ENS_OR, Relay nodes.

I.INTRODUCTION

As technology advances in society the need for wired and wireless networking has become essential. Each of these types of networking has their advantages and disadvantages according to security. Wired networking has different hardware requirements and the range and benefits are different. Wireless networking takes into consideration the range, mobility, and the several types of hardware components needed to establish a wireless network. As you read on you will understand different types of configurations of networks and the security measures that need to be taken to ensure a secure network.Energy savings 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 this paper, we focus on minimizing energy consumption and maximizing network lifetime for data relay in one-dimensional (1-D) queue network. Following the principle of opportunistic routing theory, multihop relay decision to optimize the network energy efficiency is made based on the differences among sensor nodes, in terms of both their distance to sink and the residual energy of each other. Specifically, an Energy Saving via Opportunistic Routing (ENS_OR) algorithm is designed to ensure minimum power cost during data relay and protect the nodes with relatively low residual energy.

The main contributions of this paper include the following.
1) We calculate the optimal transmission distance under the ideal scenarios and further modify the value based on the real conditions.
2) We define the concept of EEN to conduct energy optimal strategy at the position based on the optimal transmission distance.
3) We introduce the forwarder list based on the distances to EEN and the residual energy of each node into EEN for the selection of relay nodes.
4) We propose ENS_OR algorithm to maximize the energy efficiency and increase the network lifetime.

II.LITERATURE SURVEY

Wireless integrated network sensors [2]:
The authors propose that Wireless Integrated Network Sensors (WINS) now provide a new monitoring and control capability for transportation, manufacturing, health care, environmental monitoring,and safety and security. WINS combine sensing, signal processing, decision capability, and wireless networking capability in a compact, low power system. WINS systems combine micro sensor technology with low power sensor interface, signal processing, and RF communication circuits.

An adaptive approach to topology management in large and dense real-time wireless sensor networks [3]: The authors propose that Topology management protocols play an important role in WSNs, managing the sleep transitions of the nodes to make data transmissions occur in an energy-efficient way, thus prolonging network lifetime. However, classical topology management protocols are not suitable for real-time WSNs, as they may introduce unbounded delays. In a previous work, we presented a static topology management protocol specifically designed for real-time WSNs which is able to provide bounded delay and routing fidelity. This paper extends such work, presenting a dynamic topology management protocol that surpasses the static approach introducing support for event-driven data transmissions and node joining at runtime and providing a novel adaptive technique for energy balancing among nodes to further increase network lifetime. This paper provides a detailed description of the dynamic protocol and simulation results on network lifetime and routing performance with comparative assessments.

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An energy-balanced routing method based on forward-aware factor for wireless sensor networks [5]: The authors propose that As an important part of industrial application (IA), the wireless sensor network (WSN) has been an active research area over the past few years. Due to the limited energy and communication ability of sensor nodes, it seems especially important to design a routing protocol for WSNs so that sensing data can be transmitted to the receiver effectively. An energy-balanced routing method based on forward-aware factor (FAF-EBRM) is proposed in this paper. In FAF-EBRM, the next-hop node is selected according to the awareness of link weight and forward energy density. Furthermore, a spontaneous reconstruction mechanism for local topology is designed additionally. In the experiments, FAF-EBRM is compared with LEACH and EEUC, experimental results show that FAF-EBRM outperforms LEACH and EEUC, which balances the energy consumption, prolongs the function lifetime and guarantees high QoS of WSN.

Energybalanced routing protocol for data gathering in wireless sensor networks[6]:The authors propose that Energy is an extremely critical resource for battery-powered wireless sensor networks (WSN), thus making energy-efficient protocol design a key challenging problem. Most of the existing energy-efficient routing protocols always forward packets along the minimum energy path to the sink to merely minimize energy consumption, which causes an unbalanced distribution of residual energy among sensor nodes, and eventually results in a network partition. In this paper, with the help of the concept of potential in physics, we design an Energy-Balanced Routing Protocol (EBRP) by constructing a mixed virtual potential field in terms of depth, energy density, and residual energy. The goal of this basic approach is to force packets to move toward the sink through the dense energy area so as to protect the nodes with relatively low residual energy. To address the routing loop problem emerging in this basic algorithm, enhanced mechanisms are proposed to detect and eliminate loops. The basic algorithm and loop elimination mechanism are first validated through extensive simulation experiments. Finally, the integrated performance of the full potential-based energy-balanced routing algorithm is evaluated through numerous simulations in a random deployed network running event-driven applications, the impact of the parameters on the performance is examined and guidelines for parameter settings are summarized. Our experimental results show that there are significant improvements in energy

On the statistics of MFR routing in one-dimensional ad hoc networks [7]: The authors propose that The performance analysis of a wireless network significantly depends on the routing-related Statistics, power consumption, multihop communication delay and position estimation are among the parameters that are affected by the routing scheme. In this paper, statistical parameters of the most forward within range routing in 1-D ad hoc networks are investigated. Several parameters, such as the probability mass function (pmf) of the number of broadcast hops, the probability density function of the connectivity distance for a given number of hops, and the pmf of the number of hops between the source and the destination, are derived. For cases where the exact analytical results are recursive and complicated, good approximate no recursive formulas are also derived. We verify the correctness of the exact formulas and the precision of the approximate results by simulations. Some applications of the derived statistical parameters are also presented.

III.EXISTING SYSTEM

Wireless sensor network(WSN) contains many sensor nodes equipped with sensing, computing and communication devices which are short range over wireless channels. These nodes might be scattered over the large area.In thisalgorithm first determines the set of neighbors, from each neighbor to destination a single route is determined which gives the path based on random selection process so that the route is un-deterministic. Then a route which consumes minimum transmission energy is chosen as the best route.

IV. CURRENT APPROACH

Energy savings 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 this paper, we focus on minimizing energy consumption and maximizing network lifetime for data relay in one-dimensional (1-D) queue network. Following the principle of opportunistic routing theory, In terms of both their distance to sink and the residual energy of each other. Specifically, an Energy Saving via Opportunistic Routing (ENS_OR) algorithm is designed to ensure minimum power cost during data relay and protect the nodes with relatively low residual energy.In the current approach the algorithm calculates the optimal transmission distance under the ideal scenarios and further modifies the value based on the real conditions. The concept of EEN to conduct energy optimal strategy at the position based on the optimal transmission distance. The forwarder list is chosen based on the distances to EEN and the residual energy of each node into EEN for the selection of relay nodes.

V. PROPOSED METHODOLOGY

Due to evolutionary developments in the micro electromechanical systems (MEMS), the application of WSNs has notably increased. These WSN contains large number of sensor nodes those are scattered all over the network area. The introduction of the sensors over a large zone can be accomplished by either manually or without any definite pattern. These network sensors are widely used in the field of monitoring the environmental conditions, defense operations, tracking the targets and many more. For these applications there is a requirement of large power consumption which needs to be optimized and also the reliability of the network elements must be maintained.

Energy6Savingvia Opportunistic4Routing (ENS_OR) in this case algorithm places the relay nodes at regular intervals towards the sink. Then source node will find the neighbor nodes if neighbor lists contain the destination node it will stop the process if not it pick the forward node which is closer to relay node According highest ENS_OR factor, forward node is selected. If neighbor list contain the relay node it will find a relay node which is closer to destination node and stops the process.

$$ENS\_OR = \frac{1}{d_{\sin k}} + RE$$

$$Where ,$$

$$d_{\sin k} = dis\tan ce \ \ from \ \ neigbor \ \ to \ \sin k$$

$$RE = residual \ \ energy \ \ of \ \ neigbor$$

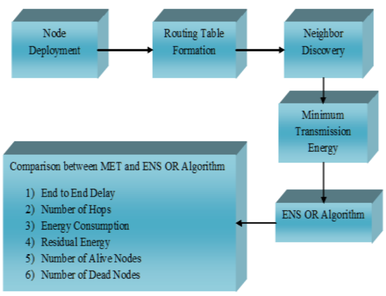
Contributions:

1) The calculated transmission distance can be further modifying6based on real4conditions.

2) To conduct energy we used the concept2of EEN (Energy equivalent nodes) based on transmission distance.

3) Based on transmission distance to EEN and residual energy relay nodes are selected.

Block diagram of proposed system:



Parameter calculations:

End To End Delay:The timer is initiated once the first packet gets transmitted into the network. Once the packet is received, an ACK is passed back to the transmitter. The amount of time taken between the packet transmission and ACK reception is called Route Discovery Time.

$E2E_{delay} = t_{stop} - t_{start}$where

t_{stop} = this is the time at which RRPLY is received

t_{start} = this the time at which RREQ is send

Number5of1Hops:The2number of intermediate links8between source node to6destination node is called Number of Hops. Energy Consumption:The energy wasted for delivering the packets from the source node to destination node. The total energy consumption is given as follows

$$TE_c = \sum_{i=1}^{l} E_i$$

$$Where ,$$

$$l = number \ \ of \ \ links$$

$$E_i = Energy \ \ consumed \ \ by \ the \ \ i^{th} \ \ link$$

The energy consumed by the i^{th} link given by

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

$$E_{tx} = energy \ \ required \ \ for \ \ data \ \ transmissi \ \ on$$

$$E_{amp} = energy \ \ required \ \ for \ \ data \ \ generation$$

$$d = dis\tan ce \ \ between \ \ two \ \ \text{int} \ ermediate \ \ nodes$$

$$\gamma = environmen \ \ t \ \ factor$$

$$0.1 \le \gamma \le 1$$

$$The \ \ S\tan dard \ \ environmen \ \ t \ \ factor$$

Number Of Alive Nodes: This is defined as the count of set of nodes whose battery level is greater than or equal to B/4, Where B is initial Battery Power Number of Dead Nodes: This is defined as the count of set of nodes whose battery level is less than B/4.Where B is initial Battery Power.

VI.RESULTS AND DISCUSSION

The implementation was with the help of MATLAB programing. During implementation, the numbers of nodes considered are 100 and the iteration carried out with 25 iterations. End to end delay, Number of hops, Energy consumed, Number of dead nodes and the numbers of a live nodes are the parameters used in this experiment. In this graph nodes are placed along with three relay nodes for 100*100 areas, the route discovered from source node 19 to destination node 37.

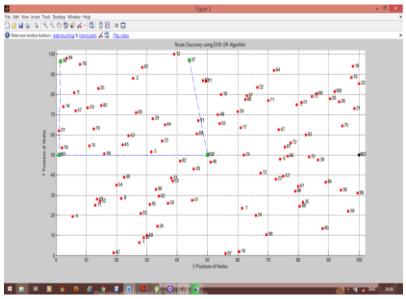


Fig 1: Route discovery from source to destination node

As shown in the below figure, the End to End delay of MET algorithm is 0.057 with respect to the 25 iterations whereas the ENS_OR algorithm End to End Delay is 0.02 with respect to the 25 iterations. Therefore with respect to route discovery time ENS_OR algorithm is best compared MET algorithm.

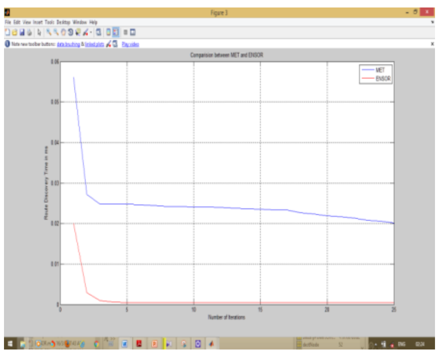


Fig 2: Route Discovery Time v/s Number of Iterations

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As shown in the below figure, the overall energy consumed by the ENS_OR algorithm is 1000J in 25 iterations which is very smaller when we compare this with the MET algorithm which takes maximum upto 125000J in 25 iterations. Hence in energy consumption also ENS_OR algorithm overcomes the MET algorithm.

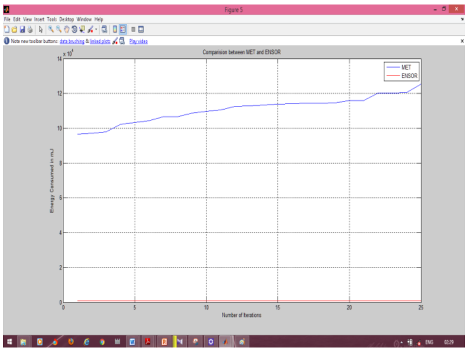

Fig 3: Energy Consumed v/s Number of Iterations

As shown in the below figure, the number of hops taken by the ENS_OR algorithm is just 5 with respect to the 25 iterations whereas the MET algorithm takes maximum upto 470 hops with5respect to the 25 iterations. Number of6hops is always less in case of8ENS_OR because of9relay nodes, As a result the ENS_OR performance in terms of Number of Hops is better than the MET.

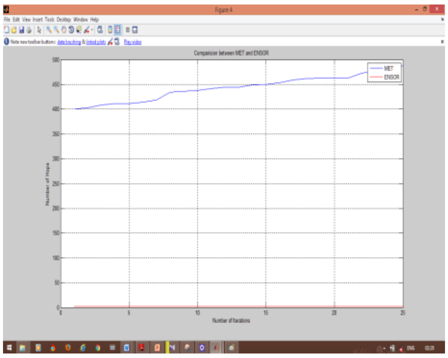

Fig 4: Number of Hops v/s Number of Iterations

As we can see in the below figure, the number alive nodes after the completion of data transmission in ENS_OR algorithm is upto 104 during 25 iterations where as in MET algorithm nodes that are alive after data transmission are just 42 in MET algorithm which is very smaller amount. Hence in case of number of alive nodes also ENS_OR algorithm overcomes MET algorithm.

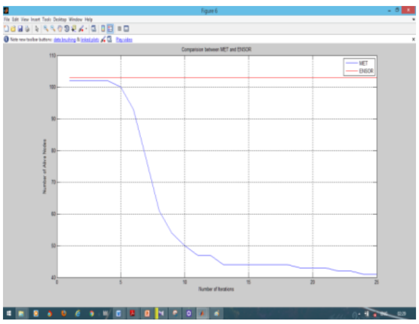

Fig 5: Number of Alive Nodes v/s Number of Iterations

VII.CONCLUSION

Energy savings optimization, therefore, becomes one of major concerns in the WSN routing protocol design. Minimizing energy consumption and maximizing network lifetime of 1-D queue network where sensors' locations are predetermined and unchangeable. For this matter, we borrow the knowledge from opportunistic routing theory to optimize the network energy efficiency by considering the differences among sensor nodes in terms of both their distance to sink and residual energy of each other. We implement opportunistic routing theory to virtually realize the relay node when actual relay nodes are predetermined which cannot be moved to the place according to the optimal transmission distance. This will prolong the lifetime of the network. Hence, our objective is to design an energy-efficient opportunistic routing strategy that ensures minimum power is cost and protects the nodes with relatively low residual energy. Numerous simulation results show that the proposed solution ENS_OR makes significant improvements in energy saving and network partition as compared with other existing routing algorithms.

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