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Efficient Relay Node Query with Replinish Energy and Fault Tolerance Minimization in WSN

S.Balavignesh, K. Elango*, N. Gunaseelan, T.G.Dhaarani

Department Of Electronics and Communication Engineering, Nandha Engineering College
Tamilnadu, India.

*Corresponding Author: Balavignesh. S

E-mail: sbalavignesh3@gmail.com

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Abstract

WIRELESS sensor network (WSN) offers a wide range of applications in areas such as traffic monitoring, medical care, inhospitable terrain, robotic exploration, and agriculture surveillance.[1].The advent of efficient wireless communications and advancement in electronics has enabled the development of low-power, low-cost, and multifunctional wireless sensor nodes that are characterized by miniaturization and integration.

1. Introduction

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. [2].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 [3]–[5]. However, the task of designing an energy-efficient routing protocol, in case of sensor networks, is multifold, since it involves not only finding the minimum energy path from a single sensor node to destination, but also balancing the distribution of residual energy of the whole network [6]. Furthermore, the unreliable wireless links and network partition may cause packet loss and multiple retransmissions in a preselected good path [7].Retransmitting packet over the preselected good path inevitably induces significant energy cost. Therefore, it is necessary to make an appropriate tradeoff between minimum energy consumption and maximum network lifetime.

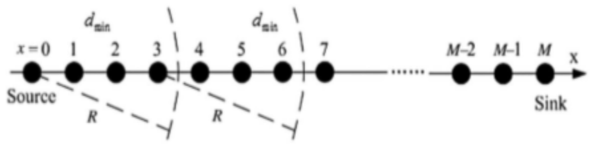
In this paper, we propose minimizing energy consumption and maximizing network lifetime for data relay. Following the principle of opportunistic routing theory, multi hop relay decision to optimize the network energy efficiency is made based on the differences among sensor nodes, in terms of both their distance to sink and the residual energy of each other.virtually derive the optimal transmission distance for energy saving and maximizing the lifetime of whole network. Since sensor nodes are usually static, each sensor's unique information,the distance of the sensor node to the sink and the residual energy of each node, are crucial to determine the optimal transmission distance; thus, it is necessary to consider these factors together for opportunistic routing decision.

The main contributions of this paper include the following.

- Reduce the Latency, that present in node selection in wireless network.
- Eliminate the problem present in sensor nodes which are present in terrain. Since it is impossible to replenish energy via replacing batteries.

2. Related Work

In recent years, there are several studies on routing-related parameters, like connectivity-related parameters and density of the distributed nodes. Some energy-efficient approaches have been explored in the literature [12]–[14]. As transmitting data consumes much more energy than other tasks of sensor nodes, energy savings optimization is realized by finding the minimum energy path between the source and sink in WSNs. In [12], the theoretical analysis about the optimal power control and optimal forwarding distance of each single hop was discussed. There is a tradeoff between using high power and long hop lengths and using low power and shorter hop lengths. With this in mind, minimum energy consumption can be achieved when each sensor node locates with the optimal transmission distance away from others in dense multihop wireless network. [13] routing approach has chooses the farthest away neighboring node as the next forwarder, and eventually results in less multihop delay, less power consumption. Another approach proposed in [14] reduces the total consumed energy based on two optimization objectives, i.e., path selection and bit allocation. Packets with the optimum size are relayed to the fusion node from sensor nodes in the best intermediate hops. Surprisingly, the benefit of optimal bit allocation among the sensor node has not been investigated in 1-D queue networks. The unreliable wireless links makes routing in wireless networks a challenging problem. In order to overcome this problem, the concept of opportunistic routing was proposed in [15].Compared with traditional best path routing, opportunistic routings, such as extremely opportunistic routing (Ex OR). [18], take advantage of the broadcast nature of the wireless medium, and allow multiple neighbors that can overhear the transmission to participate in forwarding packets. However, these routing protocols did not address exploiting OR for selecting the appropriate forwarding list to minimize the energy consumption, and optimize the design of an energy-efficient OR protocol for wire-less networks. However, these routing protocols did not address exploiting OR for selecting the appropriate forwarding list to minimize the energy consumption, and optimize the design of an energy-efficient OR protocol for wireless networks. Mao et al. [19] introduced an energy-efficient opportunistic routing strategy called energy-efficient opportunistic routing (EEOR), which selects a forwarder set and prioritizes them using energy savings optimization solution of forwarding data to the sink node in WSNs.



While all of these routing methods to improve the energy efficiency of individual node or the whole network can minimize energy consumption, it is equally important to focus on other objectives such as network lifetime and residual energy ofrelay nodes. Therefore, it is reasonable to take residual energy of sensor nodes as a primary metric into consideration.

3. Network And Energy models

In this section, the network model and energy model will be described.

3.1 Network Model

We consider a multihop WSN in a 1-D queue model as shown in Fig. 2. We assume that our scheme is targeted for relatively dense network, i.e., each relay node has plenty of neighboring nodes. Nodes have some knowledge of the location information of their direct neighboring nodes and the position of the source node and the sink node. Every wire- less sensor node has fixed maximum transmission range R and minimal transmission range dmin. The 1-D queue network is then constructed by a connected graph G =(V, E), where V is a set of sensor nodes aligned on a single line and E is a set of directed links between communication nodes. We set the indices{0,1,2,...,h,n,...,M−1,M}from left to right, and two specific nodes with index 0 and index M among them as the source node and the sink node. Let N (h) represents as the neighbor set of a node h, i.e., n ∈ N (h). Each directed link (h,n) has a nonnegative weigh w(h,n), which denotes the total energy dissipation in transmission and receiving required by node h to its neighboring node n.

3.2 Energy Model

In this work, we refer to a simplified power model of radio communication as it is used in [20] and [21]. The energy consumption can be expressed as follows: ET =(Eelec + εampdτ) B (1) where Eelec is the basic energy consumption of sensor board to run the transmitter or receiver circuitry, and εamp is its energy dissipated in the transmit amplifier. d is the distance between transmitter and receiver, τ is the channel path-loss exponent of the antenna, which is affected by the radio fre- quency (RF) environment and satisfies $2 \leq \tau \leq 4$. ET denotes the energy consumption to transmit a B-bit message in a distance d.

4. Existing System

The impact of selfish nodes in a mobile adhocnetwork from the perspective of replica allocation.

- More energy & less network lifetime.
- Due to network failure also, sometimes during query processing-specific get selfishness alarm about the particular node.

5. Drawbacks Of Existing System

Mobile nodes do not collaborate fully in terms of sharing their memory space. Replication cansimultaneously improve data accessibility and reduce query delay, i.e., query response time, if the mobile nodes in a MANET togetherhave sufficient memory

space to hold both all the replicas and the original data.

To overcome it the selfish node is detected based on credit risk value. the particular node credit risk value may be low due to network failure traffic.

- High energy.
- Less network latency.

6. Proposed System

- Minimizing fault tolerance and decreasing the latency.
- Gossoping algorithm is used to minimize the energy consumption by considering the repetation of nodes.

7. Implementation

The number of mobile nodes is set to 40. The movement pattern of nodes follows the random waypoint model, where each node remains stationary fora pause time and then it selects a random destination moves to the destination. After reaching the destination, it again stops for a pause time and repeats this behavior. The default number of selfish nodes is set to be 70 percent of the entire nodes in simulation, based on the observation of a real application. Set 75 percent of selfish nodes to be type-3 (i.e., partially selfish) and the remaining to be type-2 (i.e., fully selfish). Type-3 nodes consist of three groups of equal size. Each group uses 25, 50 and 75 percent of its memory space for the selfish area Type-2 nodes will not acceptreplica allocation requests from other nodes in the replica allocation phase, thus being expected to create significant selfishness alarm in query processing. Type-3 nodes willaccept or reject replica allocation requests according to their local status.

Define three types of behavioral states for nodes from the viewpoint of selfish replica allocation.

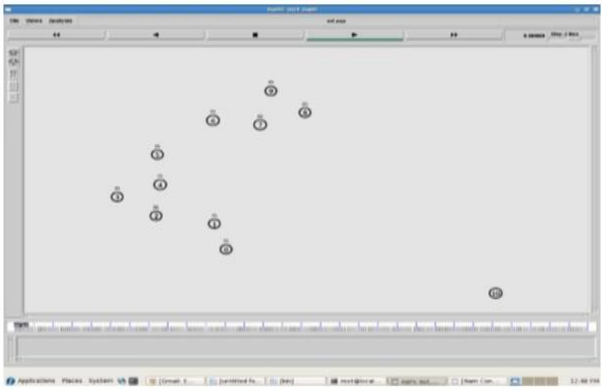
i) **Type-1 node**: The nodes are non-selfish nodes. The nodes hold replicas allocated by other nodes within the limits of their memory space.

ii) **Type-2 node:** The nodes are fully selfish nodes. The nodes do not hold replicas allocated by other nodes, but allocate replicas to other nodes for their accessibility.

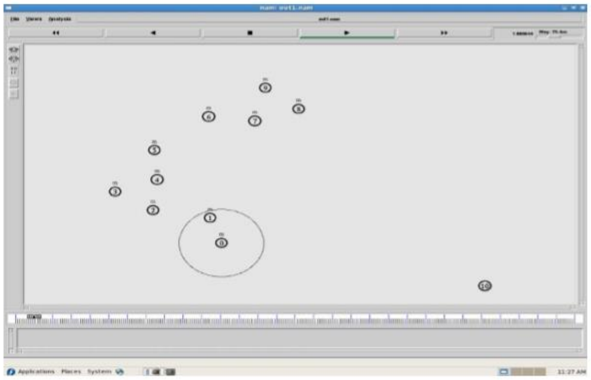
iii) **Type-3 node:** The nodes are partially selfish nodes. The nodes use their memory space partially for allocated replicas by other nodes. Their memory space may be divided logically into two parts: selfish and public area. These nodes allocate replicas to other nodes for theiraccessibility.

The detection of the type-3 nodes is complex, because they are not always selfish.

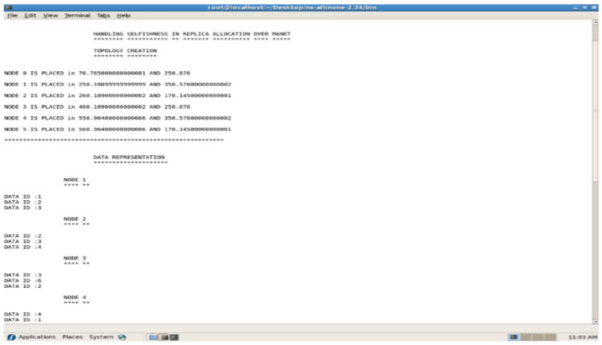
In some sense, atype-3 node might be considered as non-selfish, sincethe node shares part of its memory space. Considered it as (partial) selfish,because the node also leads to the selfish replica allocation problem. The selfish and non-selfish nodes perform the same procedure when they receive a data access request, although they behave differently in using their memory space.



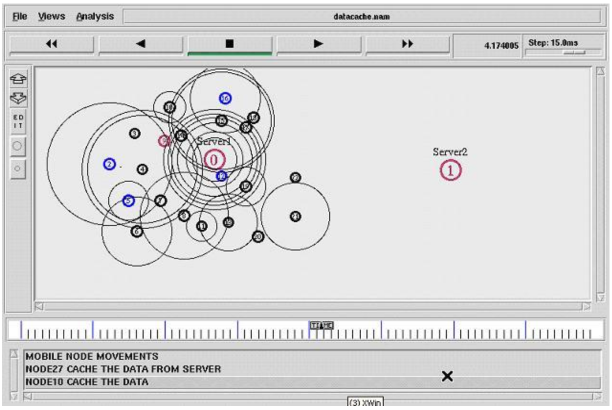
Node creation



Energy level of a Node



Node selection & Replica allocation



Energy levels of Nodes

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