© 2016 IJSRSET | Volume 2 | Issue 2 | Print ISSN : 2395-1990 | Online ISSN : 2394-4099
Themed Section: Engineering and Technology

Efficient Energy Conservation Model for Real Time Wireless Sensor Network Using Ns-3 Simulator

L. N. Pandey, Neha kushwaha
Gyan Ganga College of Technology, Jabalpur, Madhya Pradesh, India

ABSTRACT

We contemplate the vitality productive scope and availability issue in remote sensor systems (WSNs). We attempt to find heterogeneous sensors and course information produced to a base station fewer than two clashing goals: minimization of system expense and expansion of system lifetime. We go for fulfilling availability and scope prerequisites and additionally sensor hub and join limit requirements. We propose numerical details and utilize a precise arrangement way to deal with discover Pareto ideal answers for the issue. We likewise build up a multiobjective hereditary calculation to estimate the productive outskirts, as the definite arrangement approach requires long calculation times. We try different things with our hereditary calculation on arbitrarily produced issues to test how well the heuristic method approximates the effective outskirts. Our outcomes demonstrate that our hereditary calculation approximates the productive wilderness well in sensible calculation times.

Keywords: Wireless sensor networks, heterogeneous sensors, energy efficiency (lifetime), network cost, connectivity, coverage, node and link capacity, location, routing, genetic algorithm, multiobjective optimization.

I. INTRODUCTION

The development of distributed networks that are capable of sensing, computation, and wireless communication has emerged from recent processor, memory and radio technology. Today wireless sensor networks (WSN) have a wide variety of applications such as battlefield surveillance, biological detection, home security and inventory tracking. Therefore, the design of wireless sensor networks has started to attract a great deal of research attention.

A wireless sensor network consists of sensor devices deployed in a region of interest. Each sensor has processing and wireless communication capabilities, which enable it to gather information about the monitoring area and to generate and transmit the data to a base station. The base station aggregates and analyzes the data received and decides whether there is an unusual event occurrence in the monitoring area.

In wireless sensor networks, the energy source provided for sensors is usually battery power. Hence, sensors cannot operate for a long time without recharging. It is undesirable or impossible to replace the battery power of all sensors since they often work in remote or hostile area such as battlefields or disaster areas. However, a long system lifetime is expected by most of the monitoring applications. The lifetime of the network, which is measured by the time until the network no longer provides an acceptable event detection ratio, directly affects network usefulness.

Therefore, conserving the energy resource and prolonging the system lifetime is an important issue in the design of wireless sensor networks. Given possible locations where heterogeneous sensors can be deployed and a base station together with the available energy for each sensor type, we are interested in the deployment of the sensors in an efficient manner. The data sensed should be collected from all the sensors and transmitted to the base station such that total cost 14 of sensors deployed is minimized and lifetime of the network is maximized. Sensor deployment is a critical issue because it affects the cost, coverage (detection) capability and energy efficiency (lifetime) of a wireless sensor network.

Connectivity is another issue as sensors should be able to communicate in order to transmit the data to the base station. The WSN design studies in the literature are generally limited with single objective formulations. However, the problem of energy efficient coverage and connectivity of WSN has a multiobjective nature. Taking these into account, we try to handle two conflicting objectives, minimization of network cost and maximization of lifetime, together. We try to make both location and routing decisions under these two objectives. Connectivity and coverage requirements together with application specific constraints are not taken into consideration explicitly in most of the studies. Patel et al. (2004) emphasize that wireless channel capacity and finite sensor capacities should be taken into consideration in order to prevent routing of the data packets over highly congested links and paths since congestion increases the delay and packet losses, which will increase the energy consumption because of retransmission of the packets. Our study takes all of these aspects into account simultaneously for WSN design. We try to investigate the tradeoff between cost and lifetime objectives while deciding on sensor deployment and data routing. We consider locating sensors at given possible locations resulting in an adhoc network and try to model the data communication under the connectivity, coverage, node capacity and link capacity constraints.

II. METHODS AND MATERIAL

A. Related Work

Studies in the literature generally concentrate on the deployment of the sensor nodes. The problem of deployment in wireless sensor networks emerged as the base station location problem for cellular phone networks in early 1990s, as stated in Jourdan and Weck (2004). The problem was to find the optimal location of base stations (transmitters) in order to cover subscribers. This problem is different in some aspects from the wireless sensor network (WSN) planning problems. Sensor nodes in WSNs can also transmit the data to other nodes in addition to their own sensing tasks; therefore sensor nodes need to communicate with each other (connectivity). Base station location problems are similar to facility location network design problems, where location of each facility needs to be determined and the network connecting the facilities must be optimized. In WSN design it is 20 important to consider sensor deployment and network design together since location of the sensors determines the network topology. In this type of problems, sensors are manually deployed across the monitoring area. Random sensor deployment is generally preferred for military applications or inhospitable areas where deployment cannot be done manually as stated in Cardei and Wu (2006). The sensors are deployed over the monitoring area without human, e.g. by dropping from aircraft.

Data routing is another decision in WSN design. Obviously, connectivity is a requirement for data routing. In some of the studies, little or no attention is paid to the communication requirement between sensors. Some of the studies assume that connectivity is achieved if communication range of the sensor is sufficiently larger than the sensing range as in Meguerdichian and Potkonjak (2003). This assumption is not realistic since area to be covered can be disjoint, some physical obstacles like mountains and buildings can block communication. In the literature there are different objectives considered in the optimization of data routing, which are also discussed by Fabregat et al. (2004). Several routing techniques and protocols are addressed by Karaki and Kamal (2004). Algorithms for connectivity are discussed in Watfa (2007).

Another important concept for WSNs is energy efficiency. Sensor nodes are often tiny devices equipped with one or more sensors, one or more transceivers, processing and storage resources. Akyildiz et al. (2002) state that sensors have a small and finite source of energy, and they are limited in computational capacity and memory, therefore it is important to take wireless channel bandwidth limitations and sensors' processing capacities into consideration while minimizing the energy consumed in communication. This is directly related with efficient routing of the data.

Taking all of these into account, we categorize the related studies according to decisions considered. To start with deployment, sensor nodes may be deployed manually or randomly. If the sensor nodes are deployed randomly, there is not a location decision to make. Most of the studies considering given or random deployment deal with energy efficiency problems.

B. Proposed Work

Network coverage is an important issue for wireless sensor network (WSN). It is defined as the ratio of covered area by the network to the total area of interest. Thus, it indicates how well an area of interest is being monitored by a network. Ideally, network coverage is 100% although in practice it is quite difficult to achieve 100% because of several deployment issues [2]. It depends on several factors including sensing model that has been used to design the network model. Usually, a node has a limited sensing range. Any event is said to be detectable if at least one node lies within its observable range.

There are two types of reported sensing models, namely deterministic sensing model and probabilistic sensing model. Boolean sensing model falls under deterministic category. Tsai [3] has studied sensing coverage for randomly deployed WSN in shadow-fading environment. Besides these there is another reported sensing model in the literature known as Elfes sensing model [4]. Shadow-fading sensing model and Elfes sensing model fall under probabilistic category. Network coverage has been studied for WSN by several authors [5–15]. Most of the reported works [2, 5–9, 11] consider only the Boolean sensing model which is always not a realistic one. In [12], the authors have studied the impact of edge effect on network coverage for shadow-fading model. It has been shown in [13, 14] that network coverage can be improved by assuming variable sensing radius of node.
Xiaoyunet al. [14] have used the concept of geometric graph to study the coverage for randomly deployed network. In [16], we have investigated the impact of Elfes sensing model on coverage. However, node failure has not been considered extensively in determining network coverage for WSN. The sensor nodes are prone to be non-functional because of noise, battery energy depletion, software and hardware problems. Hence, it is relevant to assess network coverage considering node failure as a parameter and try to maximize it for a given application. The sensing model that is considered while a sensor network is designed plays an important role. Node failure is a very significant feature in a practical scenario.
It is obvious that failure of a node compromises the effective network coverage.

Problem Domain

Before discussing about proposed work, firstly what is sensor network.

Author of [17] gives a specific definition in his article,

Sensor Network

A sensor network consists of small size nodes with sensing, computation and wireless communication capability.

These node collaborated together by performing designed desired measurement, process measured data and transmitting it to sink node.

Author has address following problems in the article-

a) During multi-hop communication most of the battery power is consumed.
b) Another challenge is coverage area. (It can be minimize using mobility up to the optimal value)
c) Routing is a great challenge
d) Energy aware routing is required
e) But it also has cons like path selection based on lowest energy route but it produce contention (heavy load on a single path nearest to the sink)

Some researches has proposed a MRPC (Maximum Residual Packet Capacity)

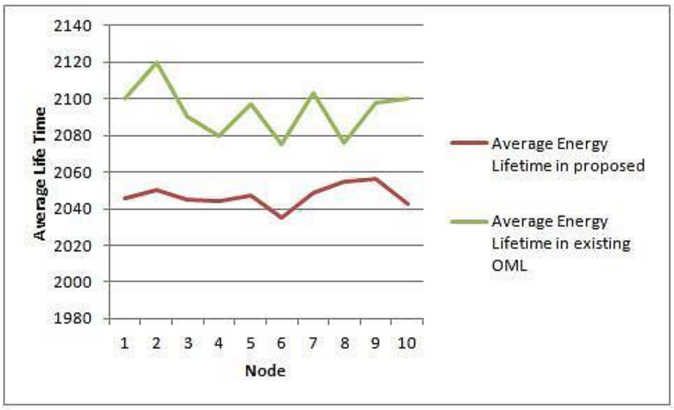
Our proposed work has following key point to be solved-

a. Performance evaluation of the routing protocols (Table driven and dynamic) in sensor network with respect to energy consumed.
b. Calculation of energy of each node during transmission
c. Proposed solution based on three parameters for best routing selection (less overhead of energy)
    i. Minimum Delay of the path
    ii. Maximum packet delivery ratio
    iii. Max residual energy remain

These 3 parameters will be the core metrics for proposed routing algorithm.NS-3.16 will be used as a testbed of sensor network.

III. RESULTS AND DISCUSSION

We have used NS3 simulator for simulating wireless sensor network in a network we have 4 mobile nodes and one sensor node which is responsible for sensing the network. Following graph show the comparison of average energy in existing OML techniques and our proposed approach



IV. CONCLUSION AND FUTURE WORK

In wireless sensor networks, the nodes which are located on a non-optimal single path and forward data packets with maximum transmission power level may run out of energy quickly. This causes network partitioning along the paths through the sensor field. Furthermore, the sink neighbors tend to lose their energy much faster than the nodes which are far away from the sink due to the fact they are carrying heavier traffic loads. This also results in network partitioning around the sink and consequently causes sink isolation phenomena. All these problems can decrease the network lifetime significantly. In recent years, many approaches were proposed to address these problems. Nevertheless, there is a need to discuss and classify these methods as well as investigate their advantages and weakness points.

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