ENERGY EFFICIENT DATA COLLECTION IN WIRELESS SENSOR NETWORK   - A SURVEY

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ABSTRACT

Wireless sensor networks are the networks that can sense, calculate and then communicate the data. To collect the data at sensor nodes consumes a lot of energy but sensor nodes are energy constraint. In this paper we will discuss an algorithm, which is energy efficient by transmission of minimum number of reference data, (i.e. minimum number of reference data transmission) number of bits required to transmit that data will also reduced and by placement of nodes in the network in such a position that the distribution of energy will balance. It will provide efficient energy consumption in case of node failure also.

Keywords: Sensor nodes, Energy Efficiency, Reference data, CDS, RCDS

1. INTRODUCTION

Wireless sensor nodes are the nodes, which can sense, compute and communicate the data. It is possible only due to the miniaturization of various components. MEMS make it possible to build all the inbuilt components in small packet. A sensor node consists of microcontroller, battery, analog to digital converter, sensing device. All these components have their own function. Due to all these components there are some factors that affect the design of sensor networks, these factors include fault tolerant, scalability, production cost, hardware constraint, sensor network topology, environment, transmission media and power consumption [1].

Of all these factors energy constraint is more fundamental. According to R.A. Powers battery capacity only doubles in 35 years. A basic wireless sensor network consists of nodes, user interface and data transmitted through Internet [2].
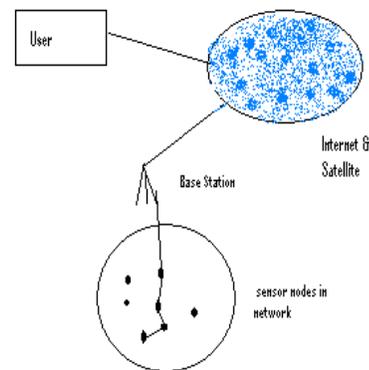
Fig: 1 wireless sensor network

Due to all these constraints, we are proposing a scheme to balance energy in the whole sensor network as the capacity of individual sensor can't be increased but we will optimize the whole network so that energy consumption is

less. Our scheme is based on the fact that energy consumption in transmission of data is more as compare in calculation. So we are proposing a scheme which can minimize the number of reference data transmission and reduce the number of bits required to transmit the data. A sensor consumes E_{elec} = 50nJ/bit to run the transmitter or receiver circuitry and E_{amp} = 100pJ/bit/m^2 for the transmitter amplifier [2]. Thus, the energy consumed by a sensor i in receiving a k-bit data packet is given by,

$$Rx_i = E_{elec} * k \qquad (1)$$

While the energy consumed in transmitting a data packet to sensor j is given by,

$$Tx_{ij} = E_{elec} * k + E_{amp} * d^2_{ij} * k \qquad (2)$$

Where d_{ij} is the distance between nodes i and j. So main requirement is to minimize the transmission of data, for this it is thought that if redundant data is not transmitted then a lot of energy saving is possible [3]. As computation of data consumes lesser energy, so we compute the data at every sensor node and transfer only that data which is actually required. For the calculation of data at each node there is requirement of reference data.

2. RELATED WORK

2.1 Energy Efficient Data Collection
Chong Liu, *Kui* Wu, and Jian Pei proposed energy efficient data collection framework [4] for the spatiotemporal correlation among sensing data. In this method whole network is divided into several sub-regions with each covered by a cluster of sensor nodes. It can effectively save energy without losing observation fidelity. With PLAMLIS algorithm the data restoration accuracy is improved and the energy consumption decreases.

2.2 Minimum Connected Dominating Set (MCDS)
In 1997 Bevan Das and Vaduvur Bharghavan Proposed MCDS routing algorithm [5], which provides shortest path for routes and updates routes quickly after node movement. For larger network hybrid routing scheme was proposed. In this scheme node failure is not considered and limited only first node death search.

2.3 OSCOR

Tao Cui, Lijun Chen, Tracey Ho, Steven H. Low, and Lachlan L. H. Andrew proposed jointly opportunistic source coding and opportunistic routing protocol for correlated data gathering in WSN [6]. It improves data gathering efficiency by exploiting opportunistic data compression and cooperative diversity associated with wireless broadcast. It involves several challenging issues across different network protocol layers. It reduces the power consumption by nearly 32% compared with an existing greedy scheme.

2.4 Practical Distributed Source Coding
Frank Oldewurtel, Marcin Foks and Petri Mahonen proposed a practical distributed source-coding scheme for deployable wireless sensor network [7]. The solution developed is particularly appropriate for monitoring and surveillance applications. This scheme provides 62% data compression and also saves bandwidth.

2.5 Directional Antenna based Connected Dominating Set (CDS)
Anindya Iqbal Nafees Ahmed Md. Mostofa Akbar proposed localized deterministic distributed heuristic to incorporate directional antennas connected dominating set [8], which ensures connectivity of wireless nodes and minimize energy for broadcasting. It causes more energy consumption as data is transmitted through longer path.

2.6 Distributed Algorithm for CDS
Stefan Funke, Alexander Kesselmany, Ulrich Meyery, Michal Segalz proposed a distributed algorithm for minimum connected dominating set [9]. It provides improvement in approximation factor of 6.91 which is due to the refined analysis of the relationship between the size of a maximal independent set and a minimum CDS in a unit disk graph

2.7 Cluster Based Routing Driven Compression
Sundeep Pattem, Bhaskar Krishnamachari, Ramesh Govindan proposed cluster based routing driven compression, which organizes the nodes into clusters [10], and within each cluster each sensor 's data is routed to a cluster head where redundant data is suppressed. There were also a number of full transmissions.

3. DISCUSSIONS

The number of papers that we have reviewed for wireless sensor networks in data collection techniques has different strong and weak points about network lifetime and energy consumption. All Data collection algorithms have to comply with a few basic requirements. The most important requirement is that a data collection algorithm has to be imperceptible. They have a set of criteria to further define the imperceptibility of an algorithm. These requirements are as follows

3.2 Network density
The network density is the number of nodes per square meter. It varies from one deployment to another and from one node to another within the same deployment depending on the node distribution.

3.2 Energy
The energy is an important parameter in a resource limited network such as the WSN as the lifetime of battery is very much limited.

3.3 Position within the network
In various works defined so far, there is no such consideration towards position of nodes but it plays a major role in consumption of energy as if the position of nodes changes energy required to transmit the data also changes.

3.4 Residual Energy
Residual energy is defined as the remaining power of a sensor node whenever topology changes, which can be an indicator of the stability of a link and the survival time of a node.

3.5 Energy Level
Energy level consists of two different ingredients in our work [11], the first definition is described as the energy level of a node which represents the amount of packets that a node can transmit to its neighbors under the constraint of residual energy, while energy level of a path is defined as the minimum value of energy level among the nodes along the path from a sensor node to the sink.

3.6 Network lifetime
It is the average number of dead nodes, as a result of path failure in terms of different data collection rounds. It presents the efficiency of rounds. It presents the efficiency of an algorithm in extending the number of living nodes so as to prolong the network lifetime.

3.7 Latency
Latency is defined as delay in receiving the data from the actual time in real time network. Latency requirement depends on the applications. In an environment surveillance application, when an event is detected, sensor nodes should be able to report the local processing result to sink in real time so that appropriate action can be taken promptly by sensor node. A sensor node is the core component of a WSN.

3.8 Base Station
The base station is at the upper level of the hierarchical WSN. It provides the communication link between the sensor network and the end-user.

3.9 Power
The power utilized in a sensor network is consumed as sensors are performing sensing, processing and communication tasks. Due to the limited energy nature of the sensor nodes, network lifetime is dependent on the efficient use of this energy.

4. RESEARCH DIRECTION

In this paper we will do placement of nodes in such a manner that consumption of energy at single node will be least and there is balance of energy and we also try to reduce the number of full Transmission so that less energy is consumed. It is being done for both loss less and lossy medium and will also reduce the difference between reference data and its near by nodes so that bits required to transmit the data will be less.

5. OUR APPROACH

In our algorithm we will work on three phases. In first phase we will place the nodes optimally in the sensor network as selection of head node saves a lot of energy. We will distribute the energy in all nodes so that a single node need not have to transmit only the reference data and node failure will be avoided. In our second phase we will reduce the number of reference data transmission. It will be done by selecting the nodes, which will, do reference data transmission

in accordance with minimum connected dominating set. In our third phase we will reduce the number of bits required to transmit the data from every node by reducing the difference between data, which was being calculated at each node. Our algorithm will save a lot of energy consumption and our sensor network lifetime will increase.

6. CONCLUSION

We conclude that our paper has reviewed a number of energy efficient techniques and all these techniques provide reduction in data transmission but these were not still so much energy efficient. Our proposed algorithm will reduce the number of reference transmission and the number of bits required to transmit that data further placement of nodes optimally will also reduce energy consumption.

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