A Generalized Framework for Energy Conservation in Wireless Sensor Network

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Abstract

A Wireless Sensor Networks (WSN) consists of spatially distributed autonomous sensors to cooperatively monitor physical or environmental conditions, such as temperature, sound, vibration, pressure, motion or pollutants. WSN contains a large number of nodes with a limited energy supply. A wireless sensor network consists of nodes that can communicate with each other via wireless links. Sensors are be remotely deployed in large numbers and operates autonomously in unattended environments. One way to support efficient communication between sensors is to organize the network into several groups, called clusters, with each cluster electing one node as the head of cluster To support scalability, nodes are often grouped into disjoint and mostly non-overlapping clusters. This paper deals about the frame work for energy conservation of a Wireless sensor network. The frame work is developed such a way that the nodes are to be clustered, electing the cluster head, performing intra cluster transmission and from the cluster head the information is transmitted to the base station.

Keywords: Wireless Sensor network, clustering, energy, cluster head.

1. Introduction

A wireless sensor network (WSN) consists of largely deployed sensor nodes which has limited battery power. Sensor nodes of WSN have the capability of self organizing the network. The transmission between the sensor nodes are done through wireless medium. WSN is used to sense the physical or environmental conditions such as temperature, sound, vibration, pressure, motion or pollutants. Unique characteristics of a WSN include:

- Limited power they can harvest or store
- Ability to withstand harsh environmental conditions
- Ability to cope with node failures
- Mobility of nodes
- Dynamic network topology
- Communication failures
- Heterogeneity of nodes
- Large scale of deployment
- Unattended operation
- Node capacity is scalable, only limited by bandwidth of gateway node.

A sensor network is composed of a large number of sensor nodes that are densely deployed either inside the environment or close to it. The position of sensor nodes need not be engineered or predetermined. This allows random deployment in inaccessible terrains or hazardous environments. Some of the most important application areas of sensor networks include military, natural calamities, health, and home. When compared to traditional ad hoc networks, the most noticeable point about sensor networks is that, they are limited in power, computational capacities, and memory. Hence optimizing the energy consumption in wireless sensor networks has recently become the most important performance objective.

The main task of a sensor node in a sensor network is to monitor events, i.e., collect data, perform quick local data aggregation, and then transmit the data. Power consumption can hence be divided into three domains: sensing, aggregation, and communication. This paper proposes a new frame work to conserve energy of WSN, thereby the lifetime of the network is increased.

2. Motivation

The wireless network topology must be approached from a point of view different from that of a wired technology. In wireless sensor network (WSN), the definition of network technology is derived from the physical neighborhood and transmission power. Much of the related research in WSN is in the area of being mobile and battery powered.

Many literatures are concentrated on finding solution at various levels of the communication protocol, including being extremely energy efficient. Energy efficiency is often gained by accepting a reduction in network performance [1]. Low- energy adaptive clustering hierarchy (LEACH) [2][3] is a new communication protocol that tries to distribute the energy load evenly among the network nodes by randomly rotating the cluster head among the sensors. Sensor protocols for information via negotiation (SPIN) [4][5] is a unique set of protocols for energy efficient communication among wireless sensors.

Pottie has studied design issues and trade-offs that need to be considered for power – constrained WSNs with low data-rate links [6] and advocates "aggressive power management at all levels", noting that the communication protocol is more helpful in reducing the power consumption than is optimizing the hardware.

3. Framework Design

Figure1 shows the framework to conserve energy of the sensor node in the WSN. The principle of the frame work is as follows

(i) To identify the changing pattern of the sensor reading of the sensor node in the network.
(ii) To identify and eliminate the redundancy of information in the base station
(iii) To identify the failed nodes and assign their duties to some other nodes
(iv) To combine the residual energy of the sensor nodes.

Sensor node is a device that receives and responds to a stimulus or signal. Sensors measure real-world conditions, such as heat or light, and then convert this condition into an analogue or digital representation.

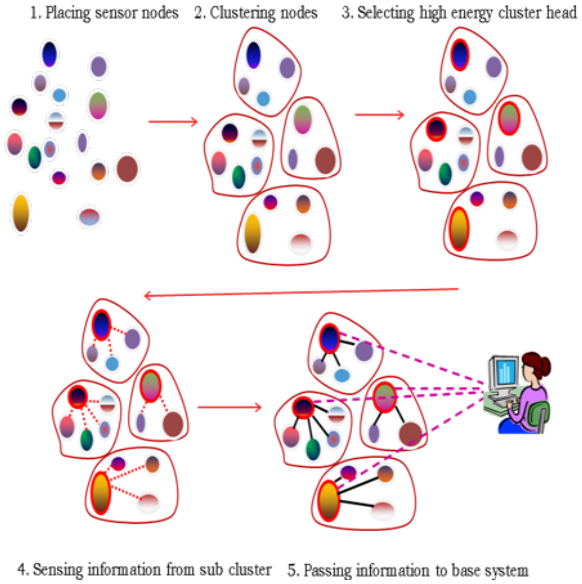

Fig. 1 Framework to conserve energy of sensor node 3.2 Equations

The steps are as follows
A Placing sensor node
B Clustering nodes
C Selecting high energy cluster head
D Sensing information from sub cluster
E Transferring information to base station

A Placing the sensor node

The architecture of a sensor node is shown in Fig 3. The sensor node consists of the sensor head, ADC, Transmitter/ Receiver and limited processor, memory and power so urce. The sensor nodes are deployed in a random manner.

Fig 2. Sensor Node

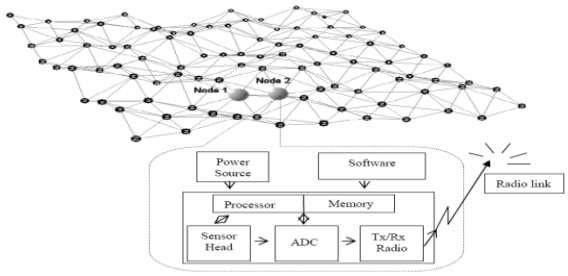

Fig 3 – Sensor Node Architecture

B Clustering Nodes

Clustering is a process by which the nodes are combined together to form a group.

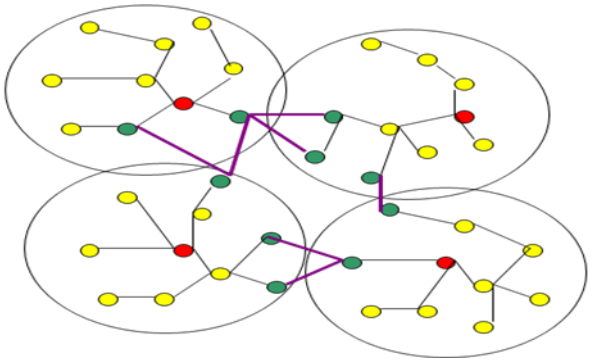

Fig 4. Clustering of sensor nodes

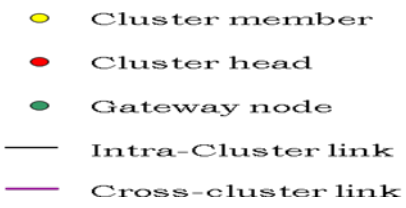

Fig 4 shows the clustering of sensor nodes into four groups. The cluster members interact with each other with the help of cluster head. Interaction is made through intra cluster link. The inter cluster communication is done using gateway node which acts as a mediator between two cluster heads with the help of a cross cluster link.

C Selecting high energy cluster head

Each cluster elects cluster head based on the energy level. The cluster head will not be stable and another cluster head is elected when the energy drains out.

D Sensing information from sub Clusters

Cluster head receives the sensed information from cluster members. The cluster head check for (i) the changing pattern of sensor reading of the cluster members and (ii) the redundancy of information obtained and eliminates the information in the cluster head.

E Transferring information to Base Station

In the network which is clustered, the cluster head transfers the data to the base station. The base station collects the data from all cluster head and checks for data redundancy and identifies the changing pattern of the sensor reading.

Psuedocode for Framework

1. S = {u1, u2, …., un}
2. Compute the distance dj from ui to uj
3. If (N(ui)) and distance dj from ui
   Ci={ui0, ui1, …, uin}
4. do
   {
   Compute E(uiI) where I = 0 to n
   CHi is the cluster head of Ci if E(UiI) is high
   Uin senses the information and passes the message to CHi
   } while (E(uiI) > E(uiJ))
5. CHi aggregates the information and passes it to base station

The proposed frame work focuses on energy conservation of the sensor node in WSN. Clustering technique is used to combine the sensor node which is within a short distance into a group. A cluster head is selected for each cluster based on the energy level of that node. The main objective is to make only the cluster head communicate with the base station so that the remaining node can be put to a sleep state. This saves the energy of each node in the cluster. When the energy of the sensor node is drops, another node with high energy in the same cluster can be selected. Clustering technique also prevents dumping the same information into the base station.

4. Conclusions

This paper mainly deals about the frame work for energy conservation of Wireless Sensor Network. The frame work involves the steps which represents the different activities that are performed to conserve the energy of wireless sensor networks. Different protocols and algorithms are to be proposed to optimize the energy in the sensor network. The protocols and algorithm has to be

identified for the steps A to E which will optimize the energy in an efficient manner.

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