A Review of IE Protocol to Increase the Uptime of the Wireless Sensor Networks

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Abstract
The primary goals of WSNs are, use of limited battery powered sensor nodes, minimum energy consumption, maximize network connectivity, and maximize network uptime. Clustering is an effective and energy efficient way to increase the uptime of wireless sensor networks. In clustering protocols, the whole network is grouped into number of clusters and each cluster has a cluster head. Cluster head is responsible for collect the information from all the non-cluster head nodes and send its information to Base station. There are some challenging issues with clustering protocols i.e.; selection of an optimal group of sensor nodes as Cluster Head (CH), Fault tolerance at the time of node failure for increase connectivity in network. We propose an Interim Election protocol for selection of cluster head node at the time of node failure to mitigate the network partitioning problem in WSNs. In proposed protocol, if cluster head die due to lack of energy or due to natural death, re-election of cluster head to be done at the time of node failure to increase the connectivity and uptime of the network

Keywords

I. Introduction
Wireless sensor network is a network consists of sensor nodes deployed over a geographical area for monitoring physical phenomenon like Temperature, Humidity, Vibrations seismic events sound, Pressure, Motion, and Or Pollutant and so on. In Wireless Sensor Network sensor nodes are linked together via some form of Wireless Communication Network. Sensor nodes are autonomous devices using for monitor the environment in which they are deployed.

Fig. 1: Wireless Sensor Network [1]

Sensor nodes are tiny devices that include three main components: a sensing subsystem for data acquisition from the physical surrounding environment, a processing subsystem for local data processing and storage, and a wireless communication subsystem for data transmission, and another main component is a power source, for supplies the energy needed by the device to perform the programmed task, power source often consists of a battery with a limited energy budget. That means it could be impossible or inconvenient to recharge the battery, because nodes may be deployed in an unreachable or unpractical environment. Wireless sensor node consists of sensing, computing, communication, actuation, and power components. These components are integrated on a single or multiple boards and packaged in a few cubic inches and also they are low-power circuit and networking technologies, a sensor node powered by 2 AA batteries can last for up to three years with a 1% low duty cycle working mode. WSN usually consists of tens to thousands of such nodes that communicate through wireless channels for information sharing and cooperative processing

A. WSNs Anatomy

Fig. 2: WSNs Anatomy

1. Processor in various modes (sleep, idle, active)
   • Sleep mode [2] is an energy-saving mode of operation in which all unnecessary components are terminated. Sensors are battery-operated devices and support a sleep mode.
   • In idle state (mode) [2] sensors do not receive or transmit, nevertheless they consume a significant amount of power.
   • Active state [2] is working state of a sensor node, in which the node is fully working and is able to transmit/receive data.
2. Power source (AA or Coin batteries, Solar Panels)
3. Memory used for the program code and for in memory buffering
4. Radios used for transmitting the acquired data to some storage site.

B. Factors Influencing WSNs Design [3]
1. Fault Tolerance
   • Fault tolerance is the ability to sustain sensor network functionalities without any interruption due to sensor node failures.
• The fault tolerance level depends on the application of the sensor networks.
• Scalability measures the density of the sensor nodes.
• Production costs, is the cost of a single node is very important to justify the overall cost of the networks.
• Hardware constraints

II. Clustering Technique
Clustering technique, in which sensor nodes are group into clusters, every cluster would have a leader, often referred to as the Cluster-Head (CH). Many clustering algorithms have been proposed in the literature; proposed clustering techniques widely vary depending on the node deployment and bootstrapping schemes. In clustering, CH may be elected by the sensors in a cluster or pre-assigned by the network designer; CH may also be just one of the sensors or a node which is highest in resources. The cluster membership may be fixed or variable. CHs may form a second tier network with other CHs or may ship the data to a base-station or sink. Clustering reduces the energy consumption, but the main problem is most energy consumption is gathered on the cluster head. To overcome this issue, in clustering method energy consumption should be distributed that could be done by choosing appropriate cluster head in each round.
If cluster head dies in the round, the whole cluster is considered as inactive for remaining rounds. Due to this event network partitioning problem are occurs and limits the uptime of the network. To enhance the network uptime, requires a mechanism for selection of cluster head in the event of failure of the coordinator node to mitigate the network partitioning problem.

III. Related Works
Wendi B. Heinzelman [4], in “An Application-Specific Protocol Architecture for Wireless Micro sensor Networks” describes that LEACH-C: BS Cluster Formation, a protocol uses a centralized clustering algorithm in set up phase for cluster formation and for cluster head selection, in which steady-state phase are the same as LEACH protocol. In the set-up phase of LEACH-C, each node sends information about its current location (possibly determined using a GPS receiver) and current remaining energy level to the BS. To select the good clusters, the BS needs to ensure that the energy load is evenly distributed among all the nodes.
For load balancing, the BS computes the average node energy, and which nodes have energy below the average cannot be the cluster heads for the current round and the remaining nodes are selected for cluster heads. In this algorithm attempts to minimize the amount of energy for the non-cluster head nodes to transmit their data to the cluster head, by minimizing the total sum of squared distances between all the non-cluster head nodes and the closest cluster head.
When the cluster heads and associated clusters are select, the BS broadcasts a message that contains the cluster head ID for each node. If a node’s cluster head ID matches its own ID, the node is a cluster head; otherwise, the node determines its TDMA slot for data transmission and goes to sleep until it is time to transmit data. In the steady-state phase of LEACH-C is processes are identical to the LEACH.
AkramulAzim, et al [5], in “A survey and related patents”, describes about the Hybrid LEACH. It is a new robust relay node based protocol, which is incorporates the recently developed energy comparison LEACH within the relay nodes based technique so that the network still operates, in absence of relay nodes, as long as even a single node having energy to communicate.

The Hybrid LEACH also maintains the efficiency of energy utilization through controlling the size of cluster in a distributed manner for the first time. New hybrid LEACH scheme reduces the packet loss and increases the network lifetime significantly. Hybrid LEACH compared with LEACH protocol and shows an improvement of 6%-30% extra network lifetime and significant reduction of packet loss during communications. Comparative analysis and simulated results shows the superiority and acceptability of the proposed scheme in the applications of WSNs.
LeventeButty, et al [6], in “Private Cluster Head Election in Wireless Sensor Networks”, describes about the clustering. In wireless sensor network clustering is a useful mechanism to cope with scalability problems.
Data aggregation process used in clustering may increase the energy efficiency of the network and assigning a special role to the cluster head nodes, makes the network more vulnerable to attacks. If, cluster head is inactive by physical destruction or jamming may the entire cluster also act inactive until the problem is detected and a new cluster head is elected.
The main focus on the problem, are call the private cluster head election problem. In this Paper, propose the first private cluster head election protocol for wireless sensor networks that is designed to hide the identity of the elected cluster head nodes from an adversary that can observe the execution of the protocol M. BaniYassein, et al [7], in “Improvement on LEACH Protocol of Wireless Sensor Network(VLEACH)”, describes a new version of LEACH protocol is proposed. The aim of V-LEACH is to reduce energy consumption within the wireless network.
In V-LEACH protocol, the cluster in the network contains; CH which is responsible for sending data to the BS received from the non-CH nodes; Vice-CH node act as a CH of the cluster in case of CH dies; Non-CH nodes are for gathering data from environment and send it to the CH. V-LEACH protocol is using a vice-CH, besides having a CH in the cluster, a vice-CH that takes the role of the CH when the CH dies. Comparison between LEACH and V-LEACH shows through simulations using OMNET++ simulator which shows that VLEACH performs better than LEACH protocol.
HeshamAbusaimehShuang [8], in “Dynamic Cluster Head for Lifetime Efficiency in WSN”, describes protocol propose a mechanism to distribute the responsibility of cluster-heads among the wireless sensor nodes in the same cluster based on the ZigBee[9] standard, ZigBee supports Adhoc On-Demand Vector (AODV) routing protocol and cluster-tree routing protocol. Cluster-tree routing protocol supports single or multi-cluster networks, each single cluster in the multi-cluster network has only one node acting as a cluster head.
These cluster-heads are fixed in each cluster during the network lifetime, so using these cluster-heads throughout the network lifetime will cause to die quickly, and the entire connected nodes to these cluster-heads will be disconnected from the main network. So, in the proposed mechanism is to distribute the role of the cluster head among the wireless sensor nodes in the same cluster increased the lifetime of the WSN by around 50% of the original network lifetime.
The objective of proposed mechanism is to illustrate a model by which to distribute the role of cluster-heads among the wireless sensor nodes and to examine its efficiency in WSNs. This protocol increase the lifetime the original AODV and cluster-tree routing protocols.
IV. Conclusion
In this paper we have described Wireless sensor networks and Clustering Techniques.
As discussed above the goals of WSNs are; use of limited battery powered sensor nodes, minimum energy consumption, maximize network connectivity, and maximize network uptime or lifetime and Clustering is an effective and energy efficient way to increase the uptime of wireless sensor networks. Thus we analyze the challenging issues with clustering protocols i.e.; selection of an optimal group of sensor nodes as Cluster Head (CH).

V. Future Scope
Wireless Sensor Networks (WSNs) numbers of sensors nodes are deployed in remote and inaccessible area, sensor nodes are great for deployment in hostile environments or over large geographical area.
As discussed earlier there are some challenging issues with clustering protocols i.e.; selection of an optimal group of sensor nodes as Cluster Head (CH), Fault tolerance at the time of node failure for increase connectivity in network. In future I would like to implement an Interim Election protocol for selection of cluster head node at the time of node failure to mitigate the network partitioning problem in WSNs to increase the connectivity and uptime of the network

References