Various Efficient Cluster based Power Saving Scheme for WSN

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Abstract:
Wireless sensor network nodes are limited with energy and need efficient routing and transmission process. Energy consumption must be quite low to make it able to resist for best application output and in the mean time it also need efficient congestion and fault tolerance mechanism. They are deployed in any geographical region in a random fashion so it is very difficult o manage fault tolerance process. We will propose a saving energy clustering algorithm to provide efficient energy consumption in such networks. The main idea is to reduce data transmission distance of sensor nodes in wireless sensor networks by using the uniform cluster concepts. In order to make an ideal distribution for sensor node clusters, we calculate the average distance between the sensor nodes and take into account the residual energy for selecting the appropriate cluster head nodes. Uniform distribution of cluster location will increase the lifetime of the nodes. In our research, we will propose the fault tolerance mechanism by finding the fail over scenario and will select the backup cluster head. In case of failure of primary cluster head, back up cluster head will take place of primary cluster head automatically. For successful implementation of our experimentation, we have done some analysis about various efficient energy saving schemes in WSN so that these schemes can be helpful in fulfilling our primary objective

Keywords: *Wireless Sensor Nodes, Fault Tolerance Cluster Head, Backup Cluster Head*

1. Wireless Sensor Networks

Recent advances in wireless communications and electronics have enabled the development of low-cost, low-power, multifunctional sensor nodes that are small in size and communicate unmetered in short distances. [4] These tiny sensor nodes, which consist of sensing, data processing, and communicating components, leverage the idea of sensor networks. Sensor networks represent a significant improvement over traditional sensors. A sensor network is composed of a large number of sensor nodes that are densely deployed either inside the phenomenon or very close to it. The position of sensor nodes need not be engineered or predetermined. [2] This allows random deployment in inaccessible terrains or disaster relief operations. On the other hand, this also means that sensor network protocols and algorithms must possess self-organizing capabilities. Another unique feature of sensor networks is the cooperative effort of sensor nodes. Sensor nodes are fitted with an onboard processor. Instead of sending the raw data to the nodes responsible for the fusion, they use their processing abilities to locally carry out simple computations and transmit only the required and partially processed data. [6] The above described features ensure a wide range of applications for sensor networks. Some of the application areas are health, military, and home. In military, for example, the rapid deployment, self-organization, and fault tolerance characteristics of sensor networks make them a very promising sensing technique for military command, control, communications, computing, intelligence, surveillance, reconnaissance, and targeting systems. [8] In health, sensor nodes can also be deployed to monitor patients and assist disabled patients. Some other commercial applications include managing inventory, monitoring product quality, and monitoring disaster areas.

2. Asynchronous Sleeps and Wakeup Procedure for Clustering

Asynchronous schemes avoid the tight synchronization among network nodes required by scheduled rendezvous schemes. They allow each node to wakeup independently of the others by guaranteeing that neighbors always have overlapped active periods within a specified number of cycles.

In Fig 1, considering sensor networks where static sensor nodes are randomly located in a given region and are placed at one hop / Multi hop distance. Considering the traffic in the network to be light, transmissions are collision free. Taking one of the deployed nodes as Gateway Node / Data collection center for transmitting the message from home network to nearby network and applying SLEEP and WAKEUP Procedure for the remaining Node in the network. Since Ng Node act as the Gateway Node / Data Collection Centre it must be always active, so the energy utilized by Ng (Gateway Node) is high when compared to other nodes in the same network. [11]

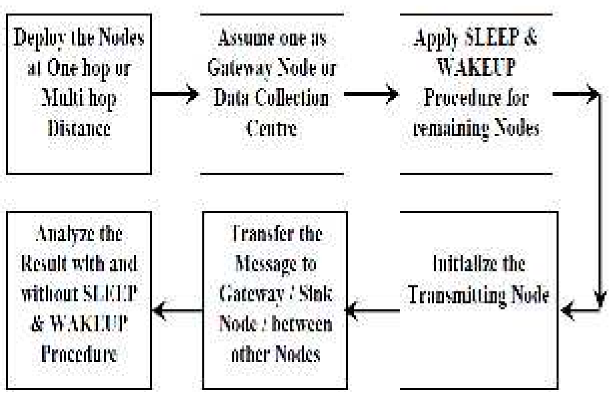

Fig. 1: Information Gathering Protocol Structure [5]

Initialize which node wants to transmit the data to gate way, the transmitter node may placed at one hop / multi hop distance, if its placed at multi hop it should transmit via intermediate nodes it can get a chance to transmit immediately / wait in mode till the intermediate node gets active. Single hop and multi hop can be both used for transmitting the data to the Gateway Node / Data Collection Center.

3. Zone-Based Fault-Tolerant Management Architecture (ZFTMA) For WSNs

ZFTMA self-organize all sensor nodes into multiple clusters to structure a fully connected WSN and perform efficient fault management operations to make network more fault tolerant. ZFTMA divides the whole network into four symmetric zones and assigns a resourceful node (knows as a Zone Manager) to each zone to distribute management tasks throughout the whole network which reduce the message exchange between nodes and Sink, hence conserve energy. [12]In this section, we will first briefly describe the network specifications and assumptions we have made needed for the design of ZFTMA. Secondly, we present the ZFTMA system overview to clearly understand the underlying design of the architecture. Details of ZFTMA network specifications and assumptions are as follows:

We assume static and homogenous sensor nodes.

Homogenous sensors have the same transmission power and radio range.

Network is divided into four Zones (such as Z1, Z2, Z3 and Z4) through Cartesian coordinate system; furthermore each zone is assigned a resourceful node: Zone Manager (ZM), which is in 1-hop direct communication with the Central Manager (CM) or sink.

We assume a sensor network to be in two-dimension plane. In Cartesian coordinate system, each point has an X-coordinate representing its horizontal position, and a Y-coordinate representing its vertical position. These are typically written as an order pair of (X, Y). In ZFTMA Cartesian co-ordinate system is applied to divide the sensor network plane area into 4 zones.

CM resides at the centre of the sensor filed. This gives us the advantage that central manager will be in equal distance to all ZMs.

Ideal percentages of cluster heads are selected at random in priori. 5 % of nodes are selected as a cluster head in ZFTMA. Calculation of ideal and optimal number of cluster heads is available in [18]. The authors verified that the optimum number of cluster is around 3-5 for the 100-node network.

4. Fault Tolerant Mechanism for Relay Node Placement

A two-tiered network model has been proposed recently for prolonging lifetime and improving scalability in wireless sensor networks. This two-tiered network is a cluster-based network. Relay nodes are placed in the playing field to act as cluster heads and to form a connected topology for data transmission in the higher tier. [14] They are able to fuse data packets from sensor nodes in their clusters and send them to sinks through wireless multi-hop paths. However, this model is not fault-tolerant as the network may be disconnected if a relay node fails. Related study a fault-tolerant relay node placement problem in wireless sensor networks. Based on place a minimum number of relay nodes to the playing field of a sensor network such that (1) each sensor node can communicate with at least two relay nodes and (2) the network of the relay nodes is 2-connected. We present a polynomial time approximation algorithm for this problem and prove the worst-case performance given by our algorithm is bounded within O(Dlog n) times of the size of an optimal solution, where n is the number of sensor nodes in the network, D is the (2; 1)¡Diameter of the network formed by a sufficient set of possible positions for relay nodes. [14]

5. Extending range method for Fault Tolerance

A heuristic approach to solve the partitioned network problem is to increase the transmission power and to extend the communication range of the nodes as needed. As in the wireless sensor grid network showed in Figure 2, a live node with level value m should have one or more next hop node located as the immediate neighbor with the level of m1. [16]

If a node detects that there is no next hop node available due to node failure, a straightforward approach is to increase its transmission power to extend the communication range.

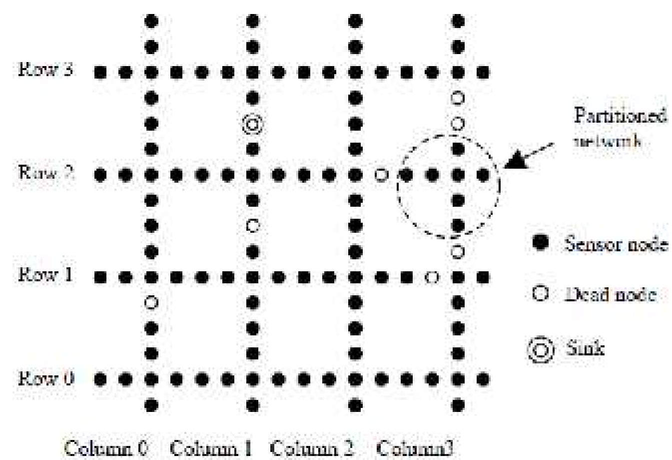

Fig.2: An example of the wireless sensor grid network.

Due to the concern of energy consumption, the power increment is limited to four times of the minimum transmission power in this paper that result in a doubled communication range according to the path loss model [15]. Equivalently, it provides the additional ability for the active nodes to skip any single dead node along the routing path. In practice, we allow a node to extend its transmission range immediately upon detecting the dead next hop node. Since the routing paths in the network largely remain intact, the route maintenance overhead is low. However, the extending range method has the disadvantage of exhaustive energy consumption, and is lack of routing flexibility. [16] It simply extends the communication range of affected nodes, but does not perform route discovery to update the routing table of other nodes in the networks. Therefore, it does not guarantee that all physically reachable nodes can be routed to the data sink through the active routing paths for a partitioned network.

6. Conclusion

Various fault tolerance based protocol schemes have been discussed and explained according to the variation in network size and effectiveness of the fault avoidance mechanisms. In our ongoing research on fault tolerance mechanism, we are proposing a fault tolerance mechanism for saving sensor energy to improve overall throughput.

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