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Enhanced Cluster Head Selection Protocol in WSN

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Abstract: ***The WSN is a battery operated network with energy consumption as main constraint. The sensing information must be obtained in an efficient manner for the long lifetime of sensor network. The base station collects the data from all nodes. Direct transmission of data from each node towards the base station consumes a lot of energy. To optimize the performance of network, nodes are arranged in the form of clusters. Each cluster contains a cluster head. Cluster head is elected by using the Fuzzy logic. Local nodes transmit data to cluster head and cluster head to the base station. The cluster head transfer data to base station in one hop. The cluster heads can be far away from base station so the direct transmission from cluster head to the base station will result in lot of energy consumption. This energy consumption is reduced by chaining the cluster heads so that the transmission will save energy. The proposed technique reduces the energy consumption hence enhance the network life. The existing protocol as well as the modified protocol is implemented using the MATLAB; and their performance is compared by varying the number of nodes.***

Keywords: ***Wireless Sensor Network, Clustering, Routing Protocols, LEACH, Energy.***

I. Introduction

Due to recent technological advances, the manufacturing of small and low-cost sensors has become technically and economically feasible. These sensors measure ambient conditions in the environment surrounding them and then transform these measurements into signals that can be processed to reveal some characteristics about phenomena located in the area around these sensors. A large number of these sensors can be networked in many applications that require unattended operations, hence producing a wireless sensor network (WSN) [1]. In fact, the applications of WSNs are quite numerous. For example, WSNs have profound effects on military and civil applications such as target field imaging, intrusion detection, weather monitoring, security and tactical surveillance, distributed computing, detecting ambient conditions such as temperature, movement, sound, light, or the presence of certain objects, inventory control, and disaster management. Deployment of a sensor network in these applications can be in random fashion (e.g., dropped from an airplane in a disaster management application) or manual (e.g., fire alarm sensors in a facility or sensors planted underground for precision agriculture). Wireless sensor networks consist of individual nodes that are able to interact with the environment by sensing or controlling physical parameters. These nodes have to collaborate to fulfill their tasks. The nodes are interlinked together and by using wireless links each node is able to communicate and collaborate with each other [1].

In most wireless sensor network (WSN) applications nowadays the entire network must have the ability to operate unattended in harsh environments in which pure human access and monitoring cannot be easily scheduled or efficiently managed or it's even not feasible at all [2]. Based on this critical expectation, in many significant WSN applications the sensor nodes are often deployed randomly in the area of interest by relatively uncontrolled means (i.e., dropped by a helicopter) and they form a network in an ad hoc manner [3]. Moreover, considering the entire area that has to be covered, the short duration of the battery energy of the sensors and the possibility of having damaged nodes during deployment, large populations of sensors are expected; it's a natural possibility that hundreds or even thousands of sensor nodes will be involved. In addition, sensors in such environments are energy constrained and their batteries usually cannot be recharged. Therefore, it's obvious that specialized energy-aware routing and data gathering protocols offering high scalability should be applied in order that network lifetime is preserved acceptably high in such environments [4].

In addition to improving the fidelity of the reported measurements, data aggregation reduces the communication overhead in the network, leading to significant energy savings. In order to support data aggregation through efficient network organization, nodes can be partitioned into a number of small groups called *clusters*. Each cluster has a coordinator, referred to as a *cluster head*, and a number of *member* nodes. Clustering results in a two-tier hierarchy in which cluster heads (CHs) form the higher tier while member nodes form the lower tier [5].

The cluster formation process eventually leads to a two-level hierarchy where the CH nodes form the higher level and the cluster-member nodes form the lower level. The sensor nodes periodically transmit their data to the corresponding CH nodes. The CH nodes aggregate the data (thus decreasing the total number of relayed packets) and transmit them to the base station (BS) either directly or through the intermediate communication with other CH nodes. However, because the CH nodes send all the time data to higher distances than the common (member) nodes, they naturally spend energy at higher rates. A common solution in order balance the energy consumption among all the network nodes is to periodically re-elect new CHs (thus rotating the CH role among all the nodes over time) in each cluster [4]. The BS is the data processing point for the data received from the sensor nodes, and where the data is accessed by the end user. It is generally considered fixed and at a far distance from the sensor nodes. The CH nodes actually act as gateways between the sensor nodes and the BS. The function of each CH, as already mentioned, is to perform common functions for all the nodes in the cluster, like aggregating the data before sending it to the BS. In some way, the CH is the sink for the cluster nodes, and the BS is the sink for the CHs. Moreover, this structure formed between the sensor nodes, the sink (CH), and the BS can be replicated as many times as it is needed, creating (if desired) multiple layers of the hierarchical WSN [4].

II. ROUTING IN WSN

Routing in wireless sensor networks differs from conventional routing in fixed networks in various ways. There is no infrastructure, wireless links are unreliable, sensor nodes may fail, and routing protocols have to meet strict energy saving requirements. Many routing algorithms were developed for wireless networks [6]. In general, routing in WSNs can be divided into flat-based routing, hierarchical-based routing, location-based routing depending on the network structure and also QOS based [1]. These protocols have further various classification such as in data centric protocols consists flooding and gossiping, SPIN, direct diffusion; in hierarchical, it contains LEACH, PEGASIS ,TEEN; and in location based: GEAR and GAF etc. Now, hierarchical routing is further explain in this section.

A hierarchical approach breaks the network into clustered layers. Nodes are grouped into clusters with a cluster head that has the responsibility of routing from the cluster to the other cluster heads or base stations. Data travel from a lower clustered layer to a higher one. Although, it hops from one node to another, but as it hops from one layer to another it covers larger distances. This moves the data faster to the base station. Clustering provides inherent optimization capabilities at the cluster heads [7].

a) LEACH

LEACH [8] stands for Low-Energy Adaptive Clustering Hierarchy and is one of the first hierarchical protocols. When the node in the network fails or its battery stops working then LEACH protocol is used in the network. Leach is self-organizing, adaptive clustering protocol in which sensor nodes will organize themselves into local clusters and cluster members elect cluster head (CH) to avoid excessive energy consumption and incorporate data aggregation which reduces the amount of messages sent to the base station to increase the lifetime of the network. Therefore this algorithm has an effect on energy saving.

Cluster head is responsible for collecting data from its cluster members. To reduce inter cluster and intra cluster collisions, LEACH uses a TDMA/code-division multiple access (CDMA). The decision whether a node elevates to cluster head is made dynamically at a time interval. However, data collection is performed periodically. Therefore, the LEACH protocol is mainly used for constant tracking by the sensor networks. When the node becomes cluster head for the current round, then each elected cluster head broadcasts information to rest of the nodes in the network. To balance the energy dissipation of nodes, the cluster heads change randomly over time [9].

III. PROPOSED SYSTEM

The main drawback of existing system is that cluster head transmit direct to the base station. But the cluster head may be at large distance from the base station. It consumes a lot of energy due to large distance covered by the data packet. The proposed system reduces the energy consumption by introducing a chain system between the cluster heads. In the proposed system, the cluster head closest to base station is known as chain leader. The cluster head farthest from the base station will transmit its data to its closest neighbor cluster head. The process goes on until data is reached to the chain leader. The chain leader transmits the data to the base station. The clusters that are far apart from the base station transmits their data to their closest cluster head and they further transfer their data to other cluster heads; until data is not reached to the chain leader. The node close to chain leader transfer data directly to the chain leader. Then the chain leader transfers the data to the base station.

IV. RESULTS

The simulation is performed on the MATLAB tool. The simulation is analyzed over different . Various parameters analyzed are as follow:

1. Throughput

Throughput or network throughput is the average rate of successful message delivery over a communication channel. This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packets per time slot.

Throughput =(Packet Size/(stopTime-startTime))*(8/1000)

2. Energy Consumption

The term energy consumption is defined as the use of energy as a source of heat or power. It is also defined in some quarters as the use of energy as a raw material in the process of manufacturing utilities.

The performance is calculated by varying number of nodes. The analysis is done on 50,10,150,200,250 number of nodes.

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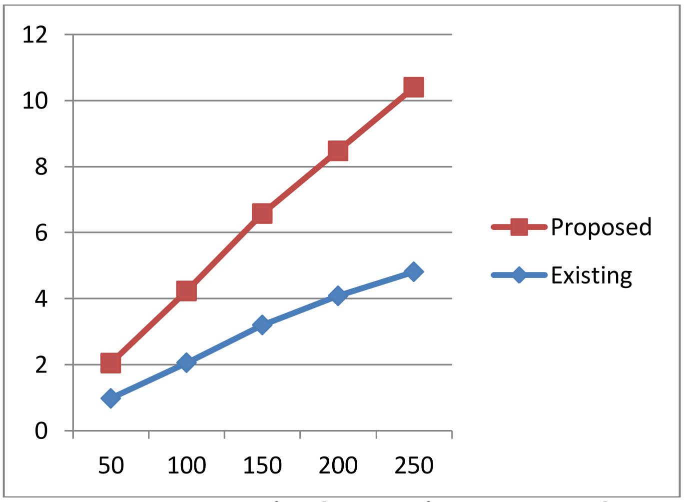

Figure1: Comparison of Total Energy Left In Various Protocol

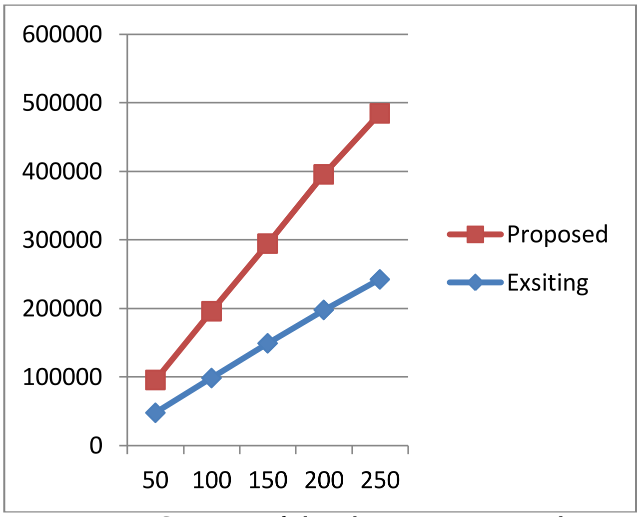

Figure 2: Comparison of Throughput In Various Protocol

V. CONCLUSION

Fuzzy based Low-Energy Adaptive Clustering Hierarchy (LEACH) is one of the most popular cluster-based routing protocols for WSNs. The LEACH minimizes energy dissipation by dividing WSNs into clusters to reduce the number of message and restrict direct communications between micro-sensor nodes and BS. The cluster head is elected by using the fuzzy. The main drawback of LEACH is that cluster head transmit direct to the base station. But the cluster head may be at large distance from the base station. It consumes a lot of energy due to large distance covered by the data packet.

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