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Implementing Data Aggregation to Improve Energy Efficiency in Wireless Sensor Networks

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Abstract: Wireless sensor network consist of spatially distributed autonomous sensor nodes to monitor physical or environmental conditions (i.e. temperature, sound, atmospheric pressure etc.) for various applications. The major designing issue with WSN is resources utilization. Subsequently, work will be carried out on clustering, routing and securing node's information for data transmission. The proposed work will be focus on minimizing power utilization during the data transmission in wireless sensor network. A data aggregation with different methods will be investigated for reducing power consumption.

Keywords: Multi Level Network Data Aggregation, clustering methods, energy efficiency, wireless sensor network.

I. INTRODUCTION

Wireless sensor network (WSN) is a collection of devoted autonomous sensor nodes that observed physical or environmental conditions differently, such as pollution levels, humidity, temperature, sound, wind direction, pressure, etc. To cooperatively deliver data through the network to a main destination. WSNs were initially designed to facilitate military applications such as battlefield surveillance; but its usages have since been drastically extended to monitoring machineries, industrial processes, health, and controls. The WSN consist of "nodes" which may be differ in numbers from a few to several hundreds or even thousands, where every node is in connection with at least one sensor.

The sensor node is equipped with a tiny processor, a small battery, a radio transceiver antenna, and situate of transducers that used to gather information. They describe the variations in the environment of the sensor node [3]. Topology for WSNs can vary from a simple star or mesh network to an advanced multi-hop wireless mesh network. The propagation of data takes place between the hops of the network with the help of routing or flooding techniques.

To attain high energy saving and long network lifetime, nodes can grouped into clusters and can be arranged in a hierarchical manner. In the working process Clustering algorithm includes partitioning of sensor nodes into several clusters, and each cluster selects one sensor node as cluster- head (CH) [2].

In clustered sensor networks, the nodes do not transmit their collected data to the sink or base station (BS), but to designated cluster heads (CH) which aggregate the data packets and send directly or via multi-hop communication to the BS [3], [8]. In-network data aggregation reduces the amount of data transmission and communication; hence the energy consumed, especially in large WSNs. The main idea is to combine partial results at intermediate nodes during data transmission [1].

II. LITERATURE SURVEY

In paper [1], they have introduced data density correlation degree and the data density correlation degree (DDCD) clustering method. With the DDCD clustering method, the sensor nodes having high correlation are distributed in the same cluster, allowing more accurate aggregated data to be obtained in cluster-based data aggregation networks produced by the DDCD clustering method. Also, the amount of data conveyed to the sink node can be minimized. The WSN is modelled by undirected graph G = (V, E). Where V is the sensor node set consisting of all sensor nodes in the WSN, E is the edge set consisting of all links in the WSN. The antenna of sensor node I ($I \in V$) aim an Omni directional antenna, with a communication radius of α (i). In cluster-based data aggregation networks, the data transmission process is that every cluster head sends aggregated data obtained from its member nodes to the sink node by one hop or multi-hops.

In paper [2], a wireless sensor network is composed of a large number of sensor nodes that are densely deployed either inside the phenomenon or very close to it. In the design aspect of wireless sensor network major challenge is energy optimization. The position of individual sensor nodes need not be predetermined. WSN consists of a wireless communication unit and a processing unit, a sensing unit, and a power supply unit. The energy source of a node is generally considered non-rechargeable. Using Energy as a vital resource in WSNs, Several MAC protocols have already been proposed to get higher energy efficiency during long idle period of the sensors. In Wireless Sensor Networks, an energy efficient medium access control protocol is required for obtaining higher energy efficiency in very difficult operating conditions, where node and link failures are common. The MAC protocol manages radio transmissions and receptions on a shared wireless medium. Therefore MAC has a very high effect on network performance and energy consumption. To save the energy of the network, the total number of sensor nodes sending data is to be reduced thereby

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decreasing the transmission of redundant data. Primary source of energy to sensor node is the battery. At regular interval of time, the nodes available in a sensor network collect the data points and transform all the data points into an equivalent electric signal and distribute the signal to the sink or base node via some reliable communication medium.

In paper [3], the basic goals of wireless sensor network are to enhance the lifetime of the network and also to use the energy of the network nodes efficiently. There are so many traditional approaches or techniques available in wireless sensor network (WSN) to achieve the above goals. But, they are not so efficient and reliable in terms of utilization of energy of the nodes in the network. Thus, Clustering is one of the key techniques to achieve the above goals in wireless sensor network with less energy consumption. It can also increase network scalability. Sensor nodes are typically considered to be homogeneous in nature since the researches in the field of wireless sensor networks have been evolved but in reality, homogeneous sensor networks hardly exist. Thus, we require a clustering technique which will work in heterogeneous environment which are more closely associated with real life scenarios. It has been made to design a heterogeneous aware clustering technique named "Multi level clustering protocol" (MLCP) in wireless sensor network in order to ensure the protocol to closely work with the real life situations. The main objective of the Multi level clustering protocol(MLCP) is to extend the stable region of wireless sensor nodes, which finally increases the life time of the network with efficient energy usage. The protocol classified the nodes into different types in term of their energy levels. Finally, the simulation result shows that MLCP gives better performance than the existing system, Low Energy Adaptive Clustering Hierarchy (LEACH) and Distributed Election Clustering (DEC) protocol.

In paper [6], Wireless sensor networks are facing many challenges such as the limited resource in processing power, storage and energy. The limited energy resource is one of the main challenges facing the security in such networks. This paper aims to improve the current security mechanisms in wireless sensor networks as well as reducing power consumption. LEACH protocol provides an energy routing protocol. However, it doesn't cover the security problems. Alternatively, its aims to provide an improved secure and more energy efficient routing protocol called LS-LEACH (Lightweight Secure LEACH). Authentication algorithm is integrated to assure data integrity, authenticity and availability. Furthermore, the improvement over LEACH protocol that makes it secure and how to make it more energy efficient to reduce the effect of the overhead energy consumption from the added security measures. Wireless sensor networks form an infra structure less wireless network where nodes are independent and self organizing.

In this paper [7], Expowave, a distributed algorithm for the scheduling of an RFID reader network. The behaviour of the algorithm is presented in detail, and its performance is evaluated through a set of simulation experiments. It is demonstrated that the algorithm constitutes an efficient approach to the reader anti-collision problem, especially in dense and lively environments. There are witnessing ubiquitous computing becoming more and more a part of our everyday lives. The proposed algorithm is proved to be of higher capacity in dense RFID reader networks. Practical use cases of such algorithms include cases when an area needs to be covered with RFID readers in a way that objects moving through are correctly and efficiently identified. In dense and lively RFID environments, two types of reader-to-reader.
This Section describes the proposed Expowave algorithm that makes the following assumptions: -Time is divided in discrete time slots. During these time slots, each node can either scan its interrogation area for RFID tags (this time slot is referred to as a color) or communicate with its neighbors (kick slot). Thus, there is no need for a distinct communication channel. -Nodes are synchronized. They do not have to know necessarily the iteration number but they need to know when a timeslot starts and ends. -Each node has the capability of detecting a collision. -Each node can communicate with its neighbors. This happens during the kick slot, as displayed Collisions during the kick slot are "kick collisions", as opposed to the previously

III. PROPOSED WORK

DATA AGGREGATION:

In WSN, sensor nodes are usually resource-constrained and battery-limited. In order to save resources and energy, data must be aggregated to avoid overwhelming amounts of traffic in the network. Gaps found in existing system are the more energy get consumed when the no-cluster head sends data to CH at a time, the collision get occur due to improper TDMA. That why the nodes have to send the data again and again until the same packet not reach successfully, it get consumed more energy and minimize the life cycle of network. Computational time required for Data Aggregation Process The recent spatial correlation models of sensor nodes' data are not appropriate for measuring the correlation in a complex environment. Densely deployed sensor nodes cause the overlapping of sensor nodes' sensing areas and the spatial redundancy of adjacent sensor nodes' data. Thus every sensor node conveys same redundant collected data to the sink node or base station consuming much more energy. The major design constraint with WSN is resources utilization. For direct communication, the nodes farthest away from the BS become critical nodes and exhaust faster than the nearest nodes, however in multi-hop communication; the nodes closest to the BS are burdened with a heavy traffic load and exhaust first.

• Packet transmission from a source node to base station located over larger distance consumes more battery power.
• To improve overall performance of sensor networks.

Objectives:

– To Decrease traffic in network
– To Increase the throughput

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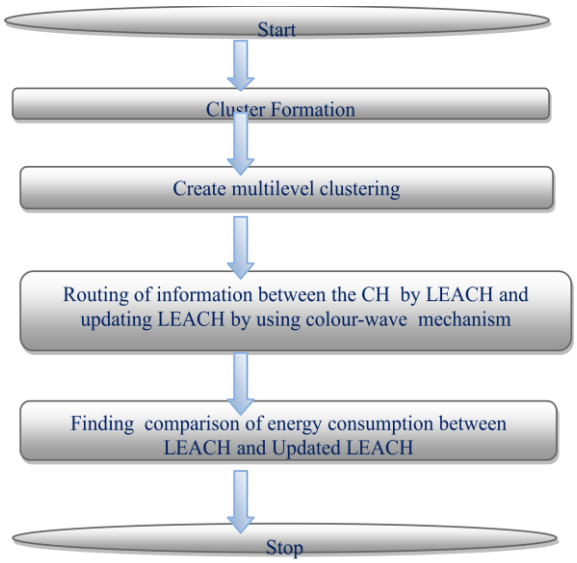
– To Increase packet delivery ratio (PDR)
– To Decrease packet loss ratio (PLR)
– To minimize battery power consumption in wireless sensor network

LEACH: 1. Cluster head (CH) create TDMA schedule for all sensor nodes in their cluster
2. All cluster head choose different CDMA codes to avoid radio interference among inter- cluster communication
3. All non cluster head send their sensed data to Cluster Head as per the assigned TDMA schedule 4. All Cluster heads aggregates data from non Cluster heads
5. All Cluster heads send their data to other cluster head which lies in between base station and itself, which in term aggregate data with their own data to reduce packet size and send it to base station.



UPDATED_LEACH:

1. Cluster head (CH) creates TDMA schedule for all sensor nodes in their cluster.
2. All cluster head choose different CDMA codes to avoid radio interference among inter cluster communication
3. All non cluster head nodes intercommunicate with each other in their respective clusters and get different color (time slot) as per expo-wave mechanism
4. If the colors (time slot) of two sensor nodes are same then again rescheduling of time slot get happens to make sure all sensor nodes have different time slot.
5. Now all the cluster heads send sensed data to cluster head as per the time assigned time slot by expo-wave mechanism
6. Cluster head send their data to other cluster heads which lies in between base station and itself which in term to aggregate data with their own data to reduce packet size and send it to base station

IV. SIMULATION RESULTS AND ANALYSIS

Papers are reviewed and analyzed related to clustering and aggregation mechanisms in WSN. Those techniques are reviewed, are different from each other, some are based on density of deployed sensor nodes, while some are based on node connectivity, energy, position, etc.

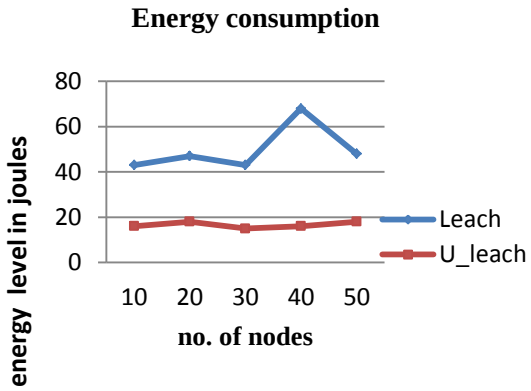


Fig 6.1 Total Energy Consumption as function of number of nodes

In fig 6.1 shows average energy consumption (joules) between LEACH protocol and proposed Updated_LEACH protocol. The proposed protocol has better performance because it tries to Average Energy Consumption (Joules) as a function of number of nodes which reduce the power consumption allowing the nodes to live longer and to reduce the collisions.

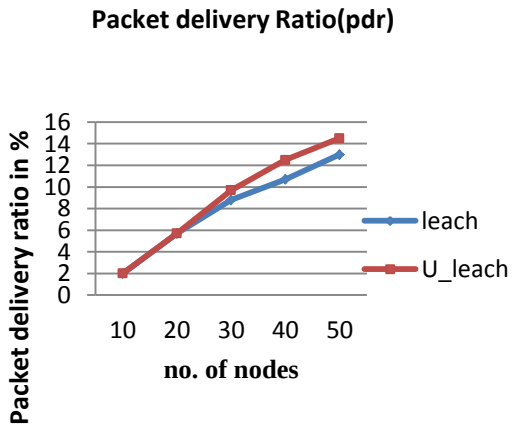


Fig 6.2 Packet delivery ratio as function of number of nodes

In fig 6.2 shows packet delivery ratio in % between LEACH protocol and proposed Updated_LEACH protocol. The proposed protocol has better performance because it tries to packet delivery ratio as a function of number of nodes which deliver more packets than previous LEACH. If the number of nodes increases the number of packet delivery ratio in % is also increases.

In fig 6.3 shows performance of average throughput in kbps between LEACH protocol and proposed Updated_LEACH protocol. The proposed protocol U_LEACH has slightly better performance in throughput as a function of number of nodes which received more number of packets than previous LEACH.

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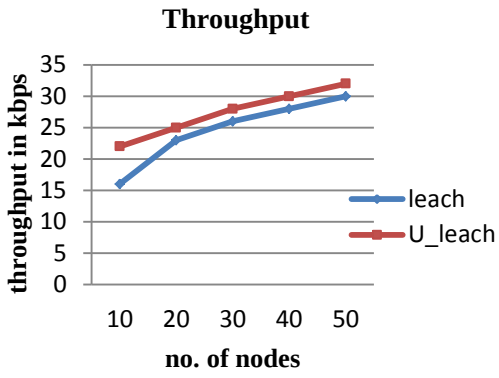

Fig 6.3 .Throughput (kbps) as a function of number of nodes.

If the number of nodes increases then average throughput is also increases.

V. CONCLUSION

The comparison of various clustering and aggregation techniques have been done and presented in this paper. The direct further work on the DDCD clustering method is developing a method which could confirm the parameters adapted to the real sampled data, especially the data threshold has major effect on clustering performance. In the data transmitting process, the energy of sensor nodes should be considered to construct an energy balanced networks. Hence, this will be researched in our future work as well. Based on the analyzed parameters, data density correlation degree and node ranking algorithms are energy efficient for immobile nodes in Wireless Sensor Network.

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