Optimal Data Aggregation Energy Clustered Routing in WSN

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Abstract- Recent development in technology supports the wide organization of Wireless Sensor Networks (WSNs). Firstly the WSNs have been considered for military applications where front lines data is collected at sensor nodes, gathered via wireless links, and interpreted at a Base Station (BS). With the development of low-cost and smaller sensor nodes, WSNs have been as of late considered for different non military personnel applications. Thus, more interest is coordinated towards enhancing diverse parts of WSNs to give better services for the public. One of the most important aspects in WSNs is the routing techniques that are used to relay data among the nodes in a WSN. Routing has a major effect on the performance and efficiency of WSNs. Energy efficiency is one of the main challenges in developing routing techniques since sensor nodes have limited amount of energy. A popular technique in saving energy and extending network lifetime is clustering, which has the advantage of being able to configure the network based on the nodes energy requirements. In this examination proposed an optimal data aggregation energy clustered routing in wireless sensor nodes.Proposed model has implemented and simulatedin Matlab and simulation results are compared with existing work.Proposed work shows better performance against data aggregation and energy consumption optimization to improve network performance as compared with previous DDECalgorithm.

Keywords-WSN,Energy based Clustering, Data Aggregation, Residual Energy,Clustering, Density, Distance.

I. INTRODUCTION

A typical WSN consists of a number of sensing nodes that collect information from the sur- rounding environment and forward it to a collector (referred to as the BS) for further processing. Sensing nodes are normally small, inexpensive, and have limited processing, computing and energy resources. Each of the sensing nodes has a data processing unit, a communication unit and apower unit. Depending on the type of application, these nodes are equipped with different kinds of sensors, such as temperature, humidity and motion detectors. The sensors gather information from the environment which will be processed and transferred to the BS or another node via a wireless link. An example of a WSN is shown in Fig. 1.1 in which the system components of a sensor node are also illustrated. WSNs have been widely used in recent years due to the low-cost and ease of deployment. Moreover, a WSN is self-organizing and can be left unattended once deployed. WSNs have great contributions in many applications such as home applications which will be discussed next.

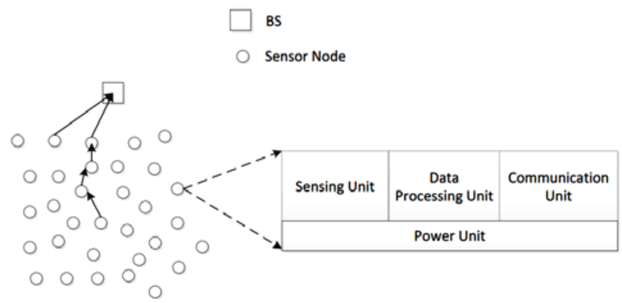

Fig. 1.1 A WSN and System components.

A broad class of applications is possible with wireless sensor networks. Potential applications include habitat and environmental monitoring, detection and prediction,target tracking, infrastructure monitoring, health applications, structural health monitoring and military applications. As sensor networks can workunattended with low deployment and maintenance cost, they enable scientists to conduct research in areas that could not previously be reached.

While sensor networks offer significant advantages for many scientific and commercial applications, the constraints on sensor nodes raise new challenges. The most important constraint on sensor nodes is their limited power supply. Sensor nodes are usually battery powered so they can operate in environments without any infrastructure. It is impractical to locate each node and replace its battery when it runs out of energy, especially when the network is deployed in wild environments. Power conservation has been well recognized by the sensor network community as a critical factor to prolong the network lifetime. Other constraints on sensor nodes include low computation and storage capability, limited wireless communication range, and susceptibility to physical damage.

Aggregation protocols for different applications, such as monitoring and periodic data collection, dynamic event detection, and target tracking, have been proposed. This examination focuses on data aggregation approaches for periodic data collection in sensor networks that monitor an area of interest. These networks require that samples be collected periodically and transmitted back to a sink node where data is to be gathered and processed. As the network is usually densely deployed, data produced by different nodes may be redundant. On the other hand, in many cases, it is the summaries, instead of the raw data, that are valuable to the researchers. Network traffic and energy consumption can be reduced by aggregating data from various nodes as it is being forwarded to the sink.

II. CLUSTER-BASED DATA AGGREGATION

Sensor networks are often densely deployed to cover the area of interest. Data produced by different neighbouring nodes may be highly correlated and redundant. For event detecting applications, the same event may be detected and reported by multiple nodes. For data collection applications, it is often the summaries (or aggregates), instead of the raw sensor readings, that are valuable to the researchers orother users. As data transmission often uses more energy than data processing, energy consumption can be greatly improved by reducing the amount of transmissions through in-network processing or data aggregation. Traditional routing protocols typically adopt the shortest-path routing method. In sensor networks, however, data centric routing, in which routing is done based on the content of the data packets, is often adopted to promote data aggregation.

In cluster-based data aggregation, nodes are grouped into clusters, with one cluster head for each cluster. Members of a cluster send packets to their cluster head via single-hop or multi-hop communication; the cluster head aggregates received data, and forwards the results to the sink, also via single-hop or multi-hop communication.

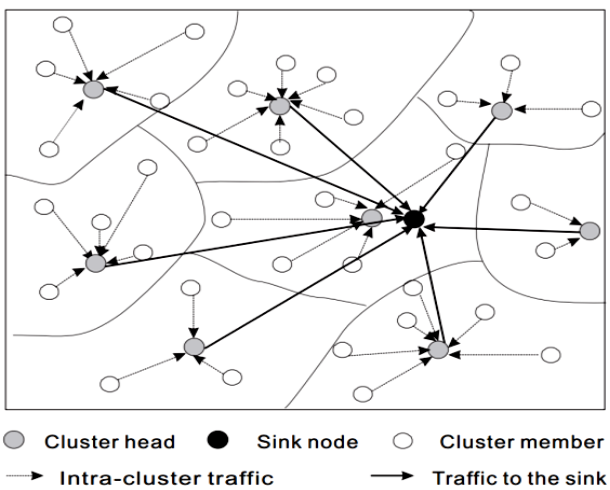

Fig. 2.1Cluster-based Data Aggregation.

In Fig. 2.3, cluster members communicate with their cluster heads directly; thecluster heads also communicate with the sink directly. Important design issues in clustering systems include energy consumption balancing, cluster head placement, and determining the optimal number of cluster heads.

LEACH (Low-Energy Adaptive Clustering Hierarchy) is a cluster-based data aggregation protocol. In LEACH, nodes are assumed to be able to adjust their power level to achieve different transmission ranges. Single-hop communication is used between cluster members and their cluster heads. A predetermined fraction of the nodes elect themselves as cluster heads based on a randomization function, and broadcast a message to the whole network. The other nodes decide which cluster they should join based on the signal level of the messages that they received.

III. PROPOSED ALGORITHM

To overcome energy efficiency issue and data aggregation optimization a cluster based energy efficient algorithm has been proposed in this work.Clustering includes selecting CHs and determining the CMs associated with each CH in order to form the different clusters.This work adopts the idea of comparing the residual energy of each node with that of its neighbors to decide whether this node is a CH or not. Determining the neighbors of each node decides on the nodes that would participate in these residual energy comparisons. This can affect the decision whether or not the corresponding node is a CH. Eventually the number of selected CHs in the network can be affected. Fig. 3.1 shows process flow of proposed algorithm.

The BS employs the status information of the nodes to configure the network. In the case of some nodes deciding not to send their status information to the BS. , the BS would determine if these nodes are alive with the same status information as in the previous round or they are dead. This is done using the nodes' old energy value that can be used to anticipate if a node is dead in the current round or it is alive with the same status information. After the BS determines the nodes' status information.

The Steps involved to design and implement proposed algorithm in Matlab are as follow

Step-1: Define various simulation parameters of ODAEVR

Step-2: Create nodes at random location in initial energy

Step-3: Update node statics

Step-4: CH election modules

Step-5: Subtract energy consumed during transmission and reception at CH.

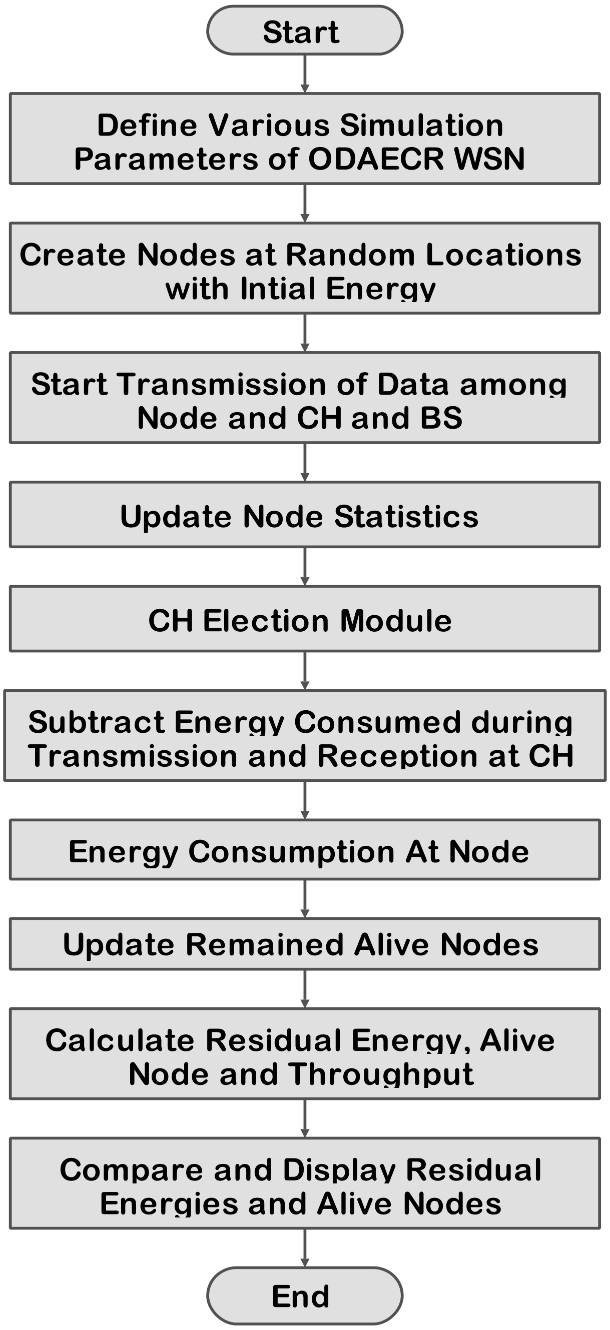

Fig. 3.1Flow Chart of the Proposed Methodology.

Step -6: Energy consumption at node

Step-7:Update remained alive nodes

Step-8:Calculate Residual energy,alive nodes and Throughput

Step-:9Compare and display residual energies and alive node.Table I: shows ODAECR Network Simulation Parameters. in table parameters and there corresponding values are given.

Table I: ODAECR Network Simulation Parameters

Parameters	***Values***
Sensing Area	500 x 500
Nodes Initial Energy	1J
Energy Cost of Sending/Receiving 1 Bit	0.5e-007J
Transmit amplifier (if d to BS < do)	E_{fs} = 10pJ/bit/4m^2
Transmit amplifier (if d to BS > do)	E_{mp} = 0.0013pJ/bit/m^4
Control Packet Length	100bit
Aggregated Packet Length	2000bit

IV. SIMULATION & RESULT ANALYSIS

To asses and compare the energy performance of proposed solution, carried out various simulations, where different processes of proposed algorithm with the same process using a protocol without data aggregation, and also there have been different comparisons with ODAECR protocols.

Simulation results show that DDEC protocol improves energy efficiency significantly by reducing the number of packets transmitted in data communication. In this simulation it is observed that as bigger is the amount of redundant data, the less data are transmitted and less energy is consumed.

Furthermore, in the protocol that is not using data aggregation, the energy consumption of the network in each iteration is always the same regardless of the amount of redundant data because all the sensor nodes send data, and will be the same number of transmissions as sensor nodes inside the network and never depending if the data are redundant or not.

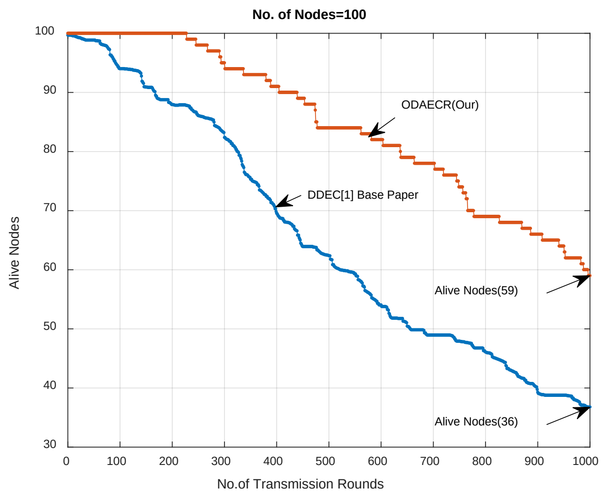

Fig. 4.1 Number of Alive Nodes vs. Rounds for n=100.

Fig. 4.1 shows the simulation outcome of proposed data aggregation algorithm which is based onclustering protocols to optimize energy and data aggregation in this figure network parameters alive nodes are plotted with respect to number of iteration.

This difference in energy consumption can be seen even more clearly if compare the amount of energy consumed in successive iterations.

Data aggregation is one of the critical concepts related to sensor networks in order to reduce the large amount of raw data being transmitted inside the clusters. Designing secure and efficient data aggregation protocols remains a key challenge to be solved.

Fig. 4.2 shows thecomparative analysis of proposed work and existing work in terms of residual energy with respect tonumber of rounds for n=100.

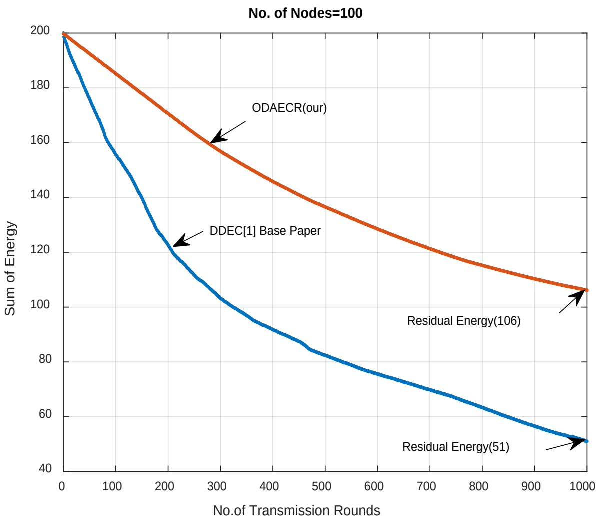

Fig. 4.2 Residual Energy vs. Rounds for n=100.

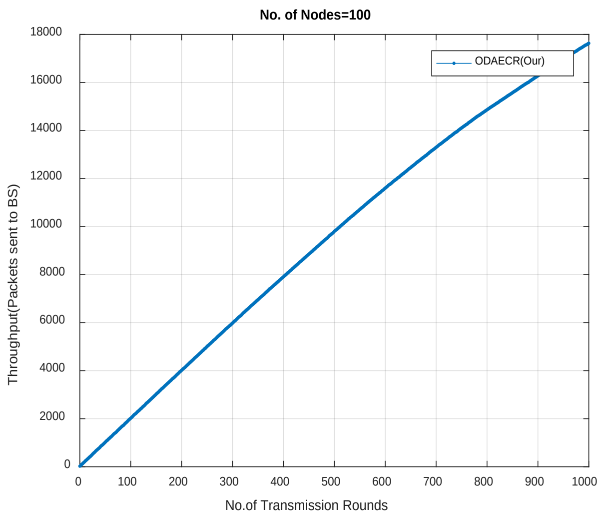

Fig. 4.3 Throughput vs. Rounds for n=100.

Fig. 4.3 shows the throughput of proposed algorithm a liner graph between packet sent to base station with respect to number of round shows the linearity and state forwardness of proposed algorithm here number of rounds n are taken is 100.

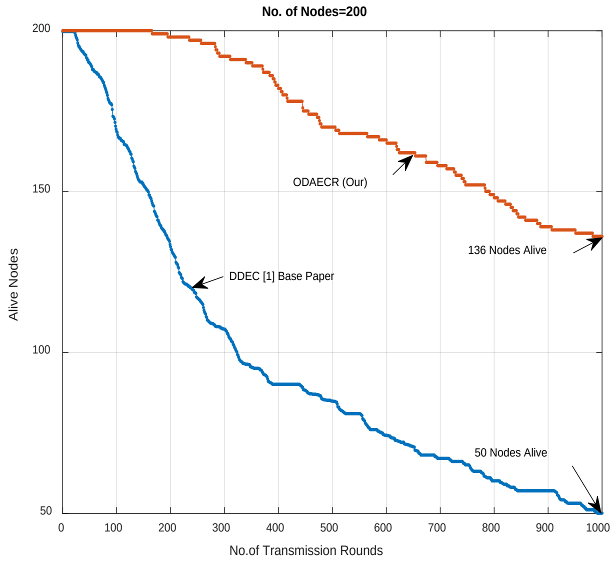

Fig. 4.4Number of Alive Nodes vs. Rounds for n=200.

Number of alive nodes for n=200 rounds represented in Fig. 4.4 where performance of proposed work with respect to previous work has shown in two different colors.

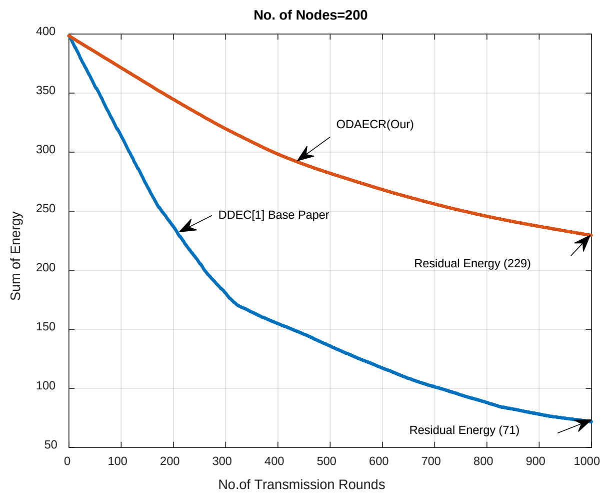

Fig. 4.5Residual Energy vs. Rounds for n=200.

Fig. 4.5 shows the curve of Residual Energy vs. Rounds for n=200 rounds. Fig. 4.6 shows the Throughput of proposed algorithm, a liner plot has shown Throughput vs. Rounds for n=200.

From Fig. 4.3 and Fig. 4.6 it can be concluded thatthe proposed ODAECRhas better stability,for n=100 rounds it shows linearity.Asincreasing number of rounds linearity of throughput remains approximately unchanged.

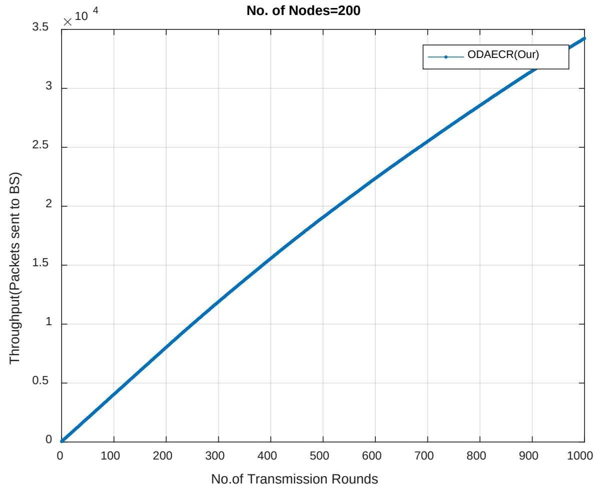

Fig. 4.6 Throughput vs. Rounds for n=200.

V. CONCLUSION

In this examination different clustering techniques and data aggregation methods have been studied. In particular, these techniques have been analyzed based on simulation in Matlab and suitable selected for wireless sensor network. The result has been to achieve a protocol that allows the data aggregation in WSN, which has been very successful optimum data aggregation, by reducing network traffic and therefore the reduction of energy consumption. The ideas enlightened in the work, such as the selection of the Cluster Head and the selection of the transmitting nodes, lead to have a more energetically balanced network. In this work, a new data aggregation protocol has been successfully developed and implemented. This protocol contributes to decrease the main problems in wireless sensor systems, as energy consumption, especially in Cluster Head nodes, that nowadays is considered as one of the biggest problems in WSN. Simulations and results show that the proposed solution improves the energy and bandwidth efficiency.. As future work to continue in this proposed solution, it is proposed to perform data compression between transmissions of aggregation data between Cluster Heads and between Cluster Head and the Base Station.

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