Development of Virtual Backbone Scheduling Technique with Clustering For Faster Data Collection in Wireless Sensor Networks

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ABSTRACT

Wireless Sensor Networks (WSNs) dominated in last two decades and it is consider as a key technology for various applications that involve lengthy processing and minimum cost monitoring, such as Battlefield Reconnaissance, Building Inspection, Security Surveillance and etc. In most WSNs, the battery is the important energy source of the sensor node. These nodes are expected to work based on batteries for continuous period times like several months or even for few years without replacing. Thus, energy efficiency becomes a critical issue in WSNs. The main objective of a sensor network is often to send the sensing data from all sensor nodes to a common sink node and then perform further analysis at the sink node. Thus, data collection process is one of the important services used in WSNs applications. In the existing techniques, different approaches have been used to sensible simulation models under the set of sensor nodes to common sink communication process known as convergecast. In the TDMA scheduling technique, it is time scheduling process based on a single frequency channel with the aim of reducing the number of time slots required (schedule length) to complete a converge cast. By using this scheduling mechanism, the data collection is higher than previous mechanisms. However, from our experimental results, this Project Work is realized that the TDMA Scheduler unable to collect data from large Sensor Networks. This is the major identified problem. To address this issue, this Project Work proposed an efficient Virtual Backbone Scheduling (VBS) Technique. Along with scheduling mechanism if we use clustering technique which will increase the life time of Wireless Sensors. To overcome this technique a novel Fuzzy Logic based approach has been introduced which will reduce the complexity of mathematical model. So, that the scheduling process can be done in faster way and which will optimize the life time of WSN. In this project work along with Virtual Backbone scheduling, the Clustering mechanism and Fuzzy Logic based approach will optimize the performance of WSN in terms of Optimized Scheduling, Faster Accessing and Faster calculations.Index Terms- Wireless Sensor Networks (WSNs), Time Division Multiple Access, Virtual Backbone Scheduling, Clustering, Convergecast , Fuzzy Logic,Tree Based Routing

I. INTRODUCTION

In Wireless Sensor Networks the data collection is one of the most important process, which is used in many applications. In WSNs set of sensor nodes and the common sink nodes are present which is communicate together. The communication from set of sensor nodes to common sink node process is called convergecast. Each sensor nodes having separate battery source, these battery energy can be used as efficient manner.

For efficient use of energy the data collection process cab be scheduled, In Wireless Sensor Networks Various scheduling process has been used. One of the most important scheduling process is (TDMA) Time Division Multiple Access. The TDMA scheduling is based on Time slots, but the TDMA scheduler cannot used for larger Sensor Networks .To overcome ,In this paper we Proposed a technique called Virtual Backbone Scheduling with fuzzy based clustering process.

II. RELATED WORK

Virtual Backbone Scheduling (VBS) [1][2], is a novel based algorithm that enables fine-grained sleepscheduling.VBS schedules multiple overlapped backbones[4] so that the network energy consumption is evenly distributed among all sensor nodes. In this scheduling VBS, is a set of backbones which will work sequentially [6] in each round. Formally, The Backbone Scheduling consists of two constraints.

Cluster-based design is one of the approaches to conserve the energy of the sensor devices since only some nodes, called cluster heads (CHs) [9][11], are allowed to communicate with the base station[5]. The CHs collect the data sent by each node in that cluster[7], compress it, and then transmit the aggregated data to the common sink. The representative design is low-energy adaptive clustering hierarchy (LEACH) [3] protocol which uses a pure probabilistic model to select CHs [10] and rotates the CHs periodically in order to balance energy consumption. However, in some cases, inefficient CHs can be selected. Because LEACH depends on only a probabilistic model, some cluster heads may be very close [8] each other and can be located in the edge of WSNs. These inefficient cluster heads could not maximize the energy efficiency. Appropriate cluster-head selection can significantly reduce energy consumption and prolong the lifetime of WSNs. Some of the clustering algorithms employ fuzzy logic to handle inconclusiveness in WSNs. Generally, fuzzy [3] [12] clustering algorithms use fuzzy logic for blending different clustering parameters to select cluster heads. To overcome the defects of LEACH, G [9] proposed to use three fuzzy descriptors (residual energy, concentration, and centrality) during the cluster-head selection.

III. PROPOSED SYSTEM ARCHITECTURE FOR VBS WITH FUZZY AND CLUSTERING TECHNIQUE

The architecture representation is shown as figure 1 . It consists of a common sink node and three clusters. Each cluster having a set of sensor nodes and cluster head, which will communicate with sink node . In fig. 1 shows that the CH1 and CH3 performing data collection process while the CH2 turns off its Radio. It will saves the energy of the WSNs battery.

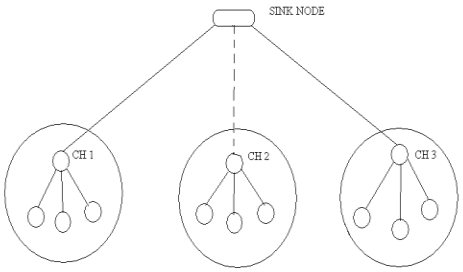

Fig. 1 System Architecture For VBS With Fuzzy and Clustering

IV. PROPOSED ALGORITHMS

In this paper Virtual Backbone Scheduling algorithm and Fuzzy Based Clustering algorithms are used.

A. VBS algorithm

In VBS algorithm it is based on Sleep Scheduling Process. In VBS, Backbone Scheduling (BS), the sensor nodes turns off its radio dynamically to save the energy of its battery. In Backbone Scheduling the sensor nodes which are present in the WSN will forward messages, which forms a backbone, the remaining sensor nodes turn off their radio to save energy of the battery.

B. Clustering

In clustering technique sensor nodes are divided into some groups, which are present in the network. Each groups having separate cluster head. In clustering nodes organized themselves into separate groups called clusters with in each cluster all nodes can communicate with each other. The information has to be forwarded to Cluster Head and in turn the cluster Head will forward the information to the nodes present in the cluster. So that the energy of each node will be saved, which will increase the life time of each node.In this paper LEACH, clustering method configures clusters in every round. In every clustering round each sensor node generates a random number between 0 and 1. If the random number for a particular node is bigger than a predefined threshold *T(n)*, which is the percentage of the desired tentative CHs, the node becomes a CH candidate. The threshold set can be calculated by using the following formula

$$T(n) = P/1 - P * \left(r \bmod \frac{1}{p}\right) \quad if\ n \in G$$

$$T(n) = 0 \quad else$$

Where P is the probability of cluster-head, r is the number of the present round and G is the group of nodes that have not been cluster-heads in the last 1/P round

C. Fuzzy Logic

To improve the performance of the WSN in this project a novel Fuzzy Logic based approach has been used. The advantage of Fuzzy logic compare to the existing mathematical model is it takes less time for calculation rather than mathematical model.In fuzzy Logic fuzzy inference systems (FIS) is used for computation of each node. Fuzzy logic control FIS consists of a fuzzifier, fuzzy rules, fuzzy inference engine, and a defuzzifier. In FIS two input variables for the FIS are the residual energy $E_{residual}$ and the expected residual energy $E_{expResidual}$, and one output parameter is the probability of a node to be selected as a CH, named chance. The bigger chance means that the node has more chance to be a CH.

$$E_{expResidual}(l, d_{toBS}, n) = E_{residual} - E_{expConsumed}$$

Where l is the data size , d_{toBS} is the distance and the n is the neighbor node .

V. IMPLEMENTATION AND RESULTS

In our implementation process we used the reconfigurable emulator for execution .The implementation window Shows in Fig. 2 ,the form with the labels like Number of Nodes, Node ID, State, Range, Elapsed Nodes, Forced Nodes and buttons such as launch, set, Enable clustering , Disable clustering start, report, graph, Exit.

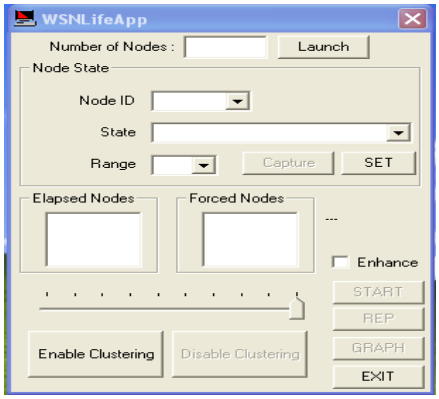

Fig. 2 Initial Window

In the number of nodes label we have to set the total number of nodes wants to launch, then the nodes can be launched, where 7 nodes has been launched .After launching the nodes it can shows different sensor nodes which is shown in Fig. 3. It can be represented as nodes launched successfully.

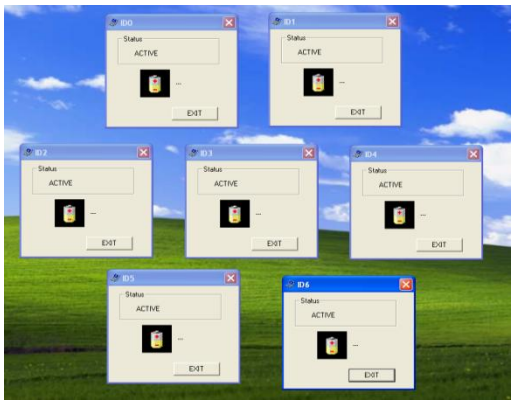

Fig. 3 Launched Nodes

A. Node State

The Form Node ID Label is used to choose various nodes ID which node we need to select its state. In the state label it consist of various states like,

1. Active
2. Transceive
3. Transmit
4. Receive

B. Clustering

In the form there are two buttons are available, these are Enable Clustering and Disable Clustering process. By selecting the enable clustering the fuzzy and clustering process are enabled . It can be shown in the Fig.4

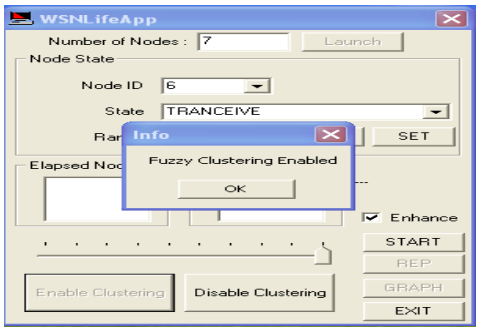

Fig. 4 Fuzzy and Clustering Enable process

C. Execution

For execution we can select the start button once we select the start button the execution process will start. While, processing the battery source can be reduced depends on the state of Sensor node which is mentioned above such as transmit, receive, transceive and active. For this processing the transceive node could elapsed earlier after elapsed the work can be transmitted to active or idle node. After completing the execution process each elapsed node work could transmitted to forced node is shown in Fig. 5.

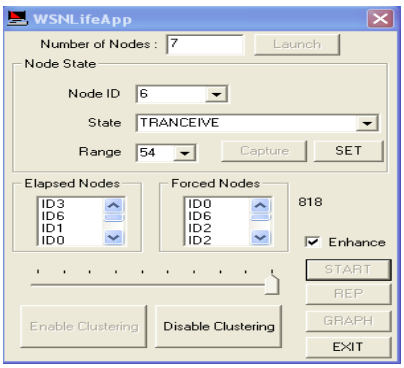

Fig.5 Execution

D. Report

After completing the execution, the report can be generated. The report that can be generated for separate techniques like TDMA, VBS and VBS with Fuzzy and clustering process .Each contains number of nodes, Wireless sensor Networks(WSNs) with stand Duration in hours, Total Data Transfer in KB, Overall Error Rate in Percentage(%), Average Life Time of Sensors in hours, Scheduling Time in ms, these are shown as follow

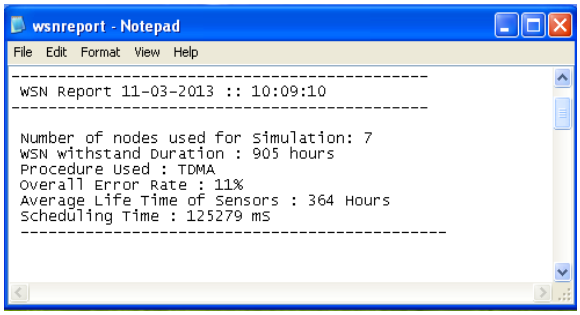

Fig.6 TDMA Report

The TDMA report that has been shown in the Fig. 6 which had the error rate life time of the sensor nodes scheduling time

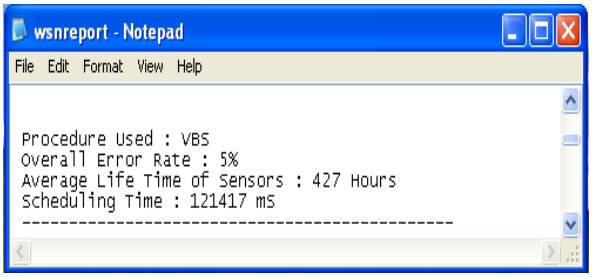

Fig.7 VBS Report

The VBS report that has been shown in the Fig.7 which had the error rate life time of the sensor nodes scheduling time.

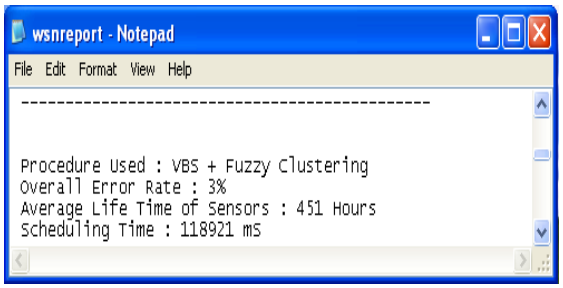

Fig.8 VBS with Fuzzy and clustering Report

The VBS with Fuzzy and clustering report that has been shown in the Fig.8 which had the error rate life time of the sensor nodes scheduling time. By comparing these reports VBS with Fuzzy and clustering process having minimizing error rate , increasing the life time of the sensor nodes and reducing the schedule time which is optimized.

VI. PERFORMANCE ANALYSIS

The result comparisons with existing and proposed graph representations are shown as following sections.

A. Life Time

The Life time comparison is shown in Fig. 9. It Shows that the TDMA Scheduling life time of the sensor node (364 Hrs) , VBS Scheduling life time of the sensor nodes (427 Hrs) and VBS with Fuzzy and clustering Scheduling Life time of the sensor nodes (451 Hrs), which will shows that out proposed VBS with fuzzy and clustering technique will improve the life time of the sensor nodes . It represent the performance of data collection will get increased by using out proposed technique VBS with fuzzy and clustering .

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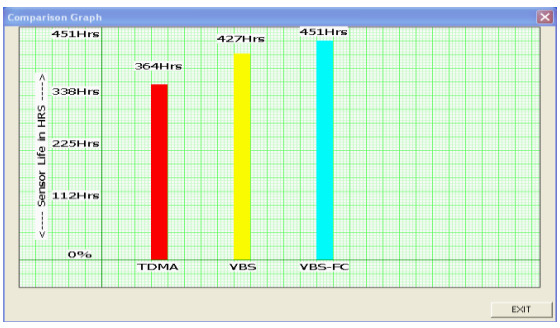

Fig. 9 Sensor Life Time Comparison

B. Scheduling Time

The Scheduling Time comparison is shown in Fig. 10. It Shows that the TDMA Scheduling Time (125279 ms) , VBS Scheduling Time (121417 ms) and VBS with Fuzzy and clustering Scheduling Time (118921 ms), which will shows that out proposed VBS with fuzzy and clustering Schedule time will get decreased . It represent the performance of data collection will get increased by using out proposed technique VBS with fuzzy and clustering.

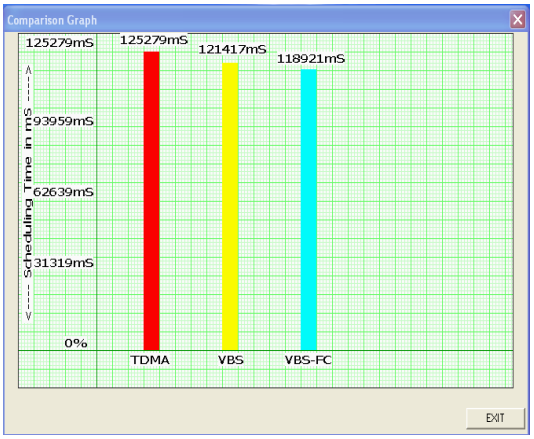

Fig.10 Scheduling Time Comparison

VII. CONCLUSION

We have developed and Implemented Virtual Backbone Scheduling with clustering and fuzzy for Faster Data collection in Wireless Sensor Networks. From our experimental results, it is observed that the proposed work improves the performance of Wireless Sensor Networks in terms of Network Error Rate, Sensor's Lifetime, Communication Cost and Scheduling Time as compared with existing technique. It is also observed that the proposed work improves the performance of Data Collection Process, which saves battery life time and the scheduling time also it will reduce the computational complexity.

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