MOBILE SINK BASED ENERGY EFFICIENT DATA GATHERING SCHEME FOR HETEROGENEOUS WSN

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ABSTRACT

Wireless Sensor Network is a well grown discipline and used in numerous number of real time applications in recent years. The data collection scheme is considered to be an effective part of sensor network. Energy Consumption and Fault Tolerance are considered to be two series factors that affect the performance of sensor network scenario. Numerous Topologies such as Hybrid, flat, chain and cluster, were adopted to provide successive data collection. The conventional scheme is CIDT (Cluster Independent Data collection Tree) uses flat topology with direct communication protocol fails to provide reliable transmission. Hence, the VELCT (Velocity Energy-efficient Link-aware Cluster Tree) technique is proposed for collecting the data in WSN, which construct Data Collection Tree (DCT) depends on Leader node(CH) location , this DCT includes Data Collection Node (DCN) which is selected based on their threshold value, connection and coverage times. This node involves only in forwarding the packets and it doesn't sense the environment, it simply collects data from leader node and delivers to Base Station this would effectively mitigate the problem such as energy conservation, delay and packet loss in the network. The simulation results also proven that, VELCT achieves better performance and throughput , quality of service than the existing schemes.

Keywords: *Link aware clustering, Data collection nodes, Data collection tree.*

1. INTRODUCTION

Wireless sensor networks is one where thousands of tiny sensor nodes where distributed in a dense region, and operated in a huge environment, with predefined sensing Capabilities to perform predefined task such as Absorbing (monitor) climatic and environmental condition. They were mainly considered in the Regions which were prone to security such as battle fields. Researcher's still found that wireless sensor network is an exciting and emerging domain of well deeply interconnected systems of low power devices. Sensor nodes in the Network have serves numerous varieties of Purposes and functions. The main task of a sensor node deployed in the field is to perform sensing such as detecting the events, transmit the collected information to the End station and perform quick data processing. However, the major factors to be considered while designing and deploying the nodes are fault tolerance capability and energy consumption by nodes. Once nodes have deployed their battery source is limited and hard to replenish, for this purpose SN should utilize the available power efficiently in a way to increase the life time of the nodes. In wireless sensor network energy efficiency is defined as the ratio between the amount of data information transmitted and the total amount of energy consumed. Energy consumption by the node parameters is directly related to the transmission distance between the sensor nodes. Hence for such reasons researchers still focus on the design of power-aware protocols and algorithms for sensor networks. This paper propose VELCT for reducing the energy consumption therefore, achieve better throughput , QoS, and reduce the Delay in the network. This VELCT

is designed with Cluster tree topology and LEACH protocol. Topology refers to a layout or arrangement of network node devices inter connected together to form a cluster. Topology management plays an important role in limiting desire factors such as energy limitation, network node failure, communication failure, delay in the network, traffic constraints, etc. Meanwhile, this topology selection itself inherently determines the types of routing path, either it is unicasting, multicasting or broadcasting and it also determines the size, type of packets. Fixing a right topology and routing protocol helps to improve the performance, throughput, lifetime of the nodes in the network and Quality of Service of the network parameters.

2. VELCT SCHEME

The ultimate aim of any sensor network is often to deliver the sensing packet from source node to destination node without loss; the proposed Velocity Energy-efficient Link-aware Cluster Tree (VELCT) method is designed with LEACH Protocol and Cluster Tree Topology, and hence it includes set-up phase & a steady-state phase. The cluster development and DCT (Data Collection Tree) Formation is carried out in phase-1 said as Set up phase; this process is initiated to identify the successive path from the cluster member to reach sink. It follows Intra cluster communication, and DCT communications. After exhibiting these connections, the steady-state phase is carried out to transfer the data packet through the optimal path selected.

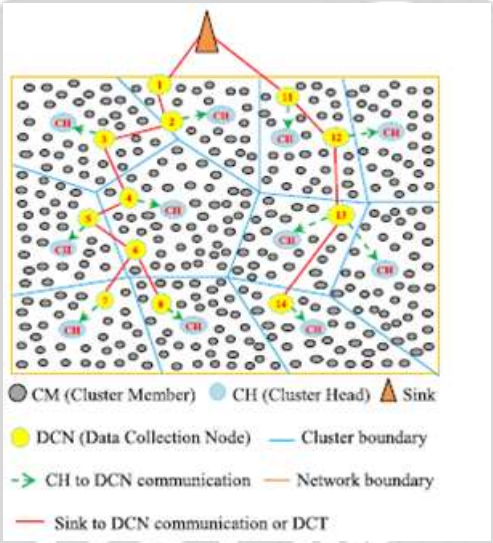

Fig-1. VELCT Structure

1.1 SETUP PHASE

The SETUP PHASE is primarily the preparation stage for the sensor environment; it is carried out by intra-cluster communication and DCN Communication. The Intra cluster communication is one in which any Sensor Node belong to one cluster can able to communicate with sensor node in another cluster without a use of gateway node. In Intra cluster communication all the sensor node members forms a cluster and elects their perspective cluster heads (CH) based on their Threshold value. Then there will be a DCT (Data Collection Tree) Communication, which involves two processes such as, Data Collection tree (DCT) Formation and Data Collection Node (DCN) Communication. It aims to collects all the data packets from all CH and perform data aggregation (removes the duplicate/ redundant packets) and forward the aggregates data packets to the DCN node through the optimal path.

1.2 STEADY PHASE

Once, setup phase is completed, steady phase is started, this involves the communication between the DCN node to sink in allotted time slot. A DCN node which is responsible only for forwarding the packets will collects a data packets from all cluster heads up to certain coverage and forwards it to the sink node. A DCN node is one which is elected by means its Connection time, coverage time and RSS in account, this DCN node will be in a random

motion and it does not participate in sensing the environment, it is designed only for the purpose of forwarding the data packets. A single DCN can be able to cover four to five cluster heads (CH) based on the coverage distance specified.

1.3 INTRACLUSTER COMMUNICATION

In a widely deployed Sensor Networks, thousands of sensor nodes have been densely deployed over the region. During the set-up phase, for the purpose advertising and identifying each node, the beacon signal is transmitted to identify the sensor nodes location (a region where it kept) and position (a place where it deployed). Once the nearby neighbor nodes are identified, an algorithm for CH (Cluster Head) election is carried out to elect the cluster head. The parameters taken into an account for electing a CH are threshold rate T, a time period to exhibit an connection between two SN (connection time) ΔE, and coverage time ΔV.

$$U_{\vartheta\varpi}^{n} = F_C + \frac{N_{\varpi}^{c}}{N_N^m - N_{\varpi}^c} \times \frac{E_N^m - E_{\varpi}^c}{E_N^m} \times \frac{V_N^m - V_{\varpi}^c}{V_N^m + V_{\varpi}^c} \times \frac{R_N^m - R_{\varpi}^c}{R_N^m + R_{\varpi}^c} \quad (1)$$

The Flag value can be determined by means of following assumptions, F=1 (for a node which act as a CH in previous rounds) and F=0 (for a node which is a current CH). In the VELCT method, the threshold rate 'T' calculated in Equation (1) is by adding the flag value obtained with the multiplication of factors such as the total number of neighbor nodes 'N', balancing energy (residual energy) 'E', current speed 'V' of nodes in transferring the packets and current coverage distance 'R' of the sensor node. After electing the CH, the next phase for Data Collection Tree formation is carried out.

Next, the distance between the cluster head and cluster member is taken into an account for optimal and stable selection of path. It is visualized by a two-Dimensional position calculation method, which is characterized as Equation (2)

$$D(N) = (X-X1) + (Y-Y1) \quad (2)$$

where *(X,Y)* are the primary node locations and D (N) be the distance between cluster head and cluster member at any time instance *t* .Now, the RSSI (Received Signal Strength Indicator) value 'I' for electing the CH from the Temporary independent node is given as,

$$I_{\vartheta\varpi}^{\varpi}(t) = I_{\vartheta\varpi}^{c}(t) - I_{\vartheta\varpi}^{m}$$
$$I_{\vartheta\varpi}^{\varpi}(t+s) = I_{\vartheta\varpi}^{c}(t+s) - I_{\vartheta\varpi}^{m}, \forall s \in t, \quad (3)$$

Hence, the above Equation can be represented in terms of G is given as,

$$G_{\vartheta\varpi}^{n} = \left(\delta_{\vartheta\varpi}^{\varpi} \times \frac{E_N^m - E_{\varpi}^c}{E_{\varpi}^c \times N_{\varpi}^c}\right) + \left(\zeta_{\vartheta\varpi}^{\varpi} \times \left(1 - \frac{I_{\vartheta\varpi}^m}{I_{\vartheta\varpi}^c}\right)\right) + \left(\eta_{\vartheta\varpi}^{\varpi} \times \frac{d_{\varpi\vartheta} - D_{\vartheta\varpi}^{\varpi}(t)}{D_{\vartheta\varpi}^{\varpi}(t)}\right) + \left(\kappa_{\vartheta\varpi}^{\varpi} \times \frac{\Delta t_{\vartheta\varpi}^{\varpi}}{t_c^f}\right), \quad (4)$$

whereas, E is the initial energy,
N is the total number of neighbor nodes,
I is the minimum RSSI value,
Δt is the estimated time to provide connection between cluster member and CH.

3. DATA COLLECTION TREE COMMUNICATION

The Data Collection Tree communication phase initiated after the completion of intra cluster communication. It involves two Processes such as, Data Collection tree (DCT) Formation and Data Collection Node (DCN) Communication. It aims to collects all the data packets from all CH and perform data aggregation (removes the duplicate/ redundant packets) and forward the aggregates data packets to the DCN node through the optimal path. Consequently, Data Collection Tree formation is initiated, which connects the cluster head and sink through DCN. For this purpose, the sink forms the Data Collection Tree , Based on the location of cluster head a few numbers of nodes are selected as DCN to generate DCT. The Process is explained in DCT construction algorithm. However, it does not participate in sensing and is not a part of any cluster on that particular round it act as an ordinary sensor node only for forwarding the packet. In this case, the selection of DCN does not affect the data collection of a corresponding cluster. By using tree topology, the expansion of the network is possible at any time, and we could easily identify the affected node, without consuming more energy and time. Hence, it have better connection time with the nearest DCN and cluster head.

3.1 STEPS FOLLOWED

[i] Selection of parameters.
(a) Number the DCT that covers all cluster head in the network.
(b) Declare the nearby nodes as NN (Neighbor Node) iterate it and include in TIN table.
(c) Identify Temporary Independent Node (TIN) from NN.
(d) Maintain TIN Table and assign a NN.

[ii] Parameter Declaration
(e)Verify 1 hop distance NN is CH or not
(f) If it was not an CH yet, set its identity as CNI (Cluster Node identity)
(g) Include CNI value in TIN Table.
(h) Return null value.

[iii] DCN Process
(i) Develop and Generate the Data Collection Tree (DCT).
(J) Increment 'i' to next iteration for further TIN selection.
(k) Declare TIN (0) to select best value in TIN Table.
(l) Declare it as DCN
(m) Include DCN in DCT.
(n) Hop Count is incremented further, to identify the one-hop distance Sensor Node from DCN for next DCN selection.
(o) Repeat the process.

4. RESULT AND ANALYSIS

The performance of the Velocity Energy-efficient Link aware Cluster Tree, fewer than three parameters such as throughput, Delay, and Energy Consumption is analyzed in this section. The Network Simulator (NS-2) of version 2.28 is used as a tool to carry out the performance.Study of VELCT with respect to existing Cluster Independent Data Tree (CIDT). A Wireless Sensor Network Environment that includes 50 nodes were used in the Simulation scenario. The data packet size among the network is 286 bytes, the range of transmission within the cluster is set as 50m. Consequently, its sensing range is 25m. The initial energy for all nodes is given as 100 Kilowatt and the Maximum Mobility speed of sensor nodes vary up to 20 m/s.

The figure 2 demonstrates the performance of VELCT scheme with CIDT in terms of Throughput. In general, Throughput refers how much successive data packet can be transmitted from one node to another in a specified time interval.

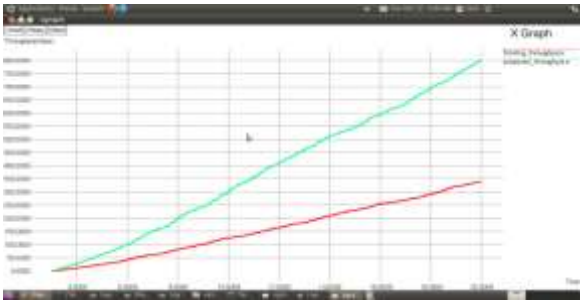

Fig-2. Network Throughput

Y → Time in Millisecond
X → Successful number of packet transmitted
As VELCT uses only Stable Links, it avoids unwanted control packet flooding in the network. Hence, the graphical results also proven the VELCT technique can achieve better throughput than existing CIDT. It shows VELCT achieves 25% better Throughput then the existing schemes.
The figure 3 illustrates the Delay factor in the Network. Delay in the network usually specifies the duration how long it takes for a packet or data to travel across the predefined path in the network. (i.e.) from one node to another.

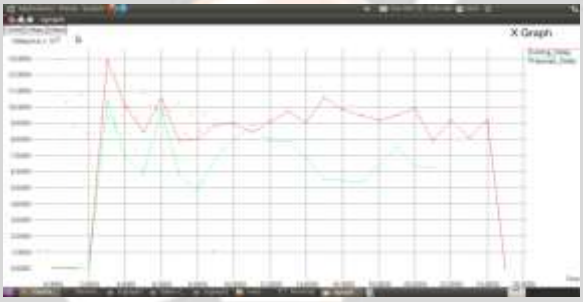

Fig.3. Network Delay

X → Time in millisecond
Y → Total number of SN.
The above graph shows the performance of delay with respect to total number of sensor nodes. As VELCT uses DCN which offers shortest path to reach sink node, the packet delivery ratio is at its maximum and also the maximum connection time to reach the base station is reduced. This graphical results also proven, that VELCT offers minimum delay when compared to the existing CIDT.
Figure 4 illustrates the performance of VELCT in terms of Energy and Time consumption.

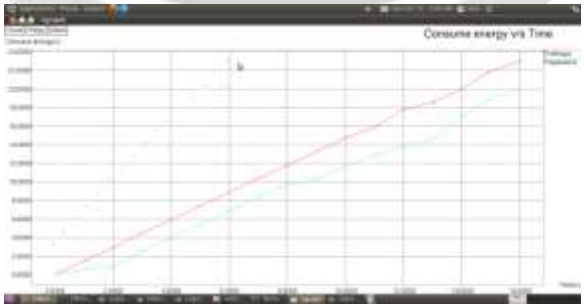

Fig-4. Energy Vs Time consumption

From the simulation n results, it can be enunciated that the VELCT concept provides a stable link and adopt itself to high mobility. As sensors in this scheme consider residual energy in account, it have the balancing capability in all

worst criteria's and prolong the lifetime of nodes in the network and hence it achieves reliability in the network. In addition, it also provides a better quality communication. From the simulation and graphical results obtained, it is revealed that VELCT provides maximum throughput, and energy utilization with reduced network traffic than existing CIDT.

5. CONCLUSION

On Account of considering the wide and raising the impact of WSNs on real-time applications over recent years, it has been known that thousands of sensor nodes is required to monitor the large-scale areas. From this paper, it has proven, that VELCT (Velocity Energy-efficient and Link-Aware Cluster-Tree) it is a proficient method to construct mobility-based auspicious network management architecture for WSNs, to increase the lifetime of network nodes, Time Taken to provide connection between two nodes, residual (balancing) energy, maximum number of packet transmitted, and stable link for mobile sensor nodes. The sensor nodes provide a stable link and adopt itself to high mobility. As sensors in this scheme consider residual energy in account, it have the balancing capability in all worst criteria's and prolong the lifetime of nodes in the network and hence it achieves reliability in the network. In addition, it also provides a better quality communication.

6. REFERENCES

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