

ENERGY BASED ROUTING ALGORITHM USING SPANNING TREE FOR MULTICLUSTER FORMATION IN WSN

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Abstract— *The data aggregation and in-network processing approaches is to combine the data arriving from different sources (sensor nodes) at certain aggregation points (or simply aggregators) in route, eliminate redundancies by performing simple processing at the aggregation points, and minimize the total amount of data transmission before forwarding data to the external base station (BS). Removing redundancies results in transmitting fewer numbers of bits, and hence reduces energy consumption and increases the sensor nodes lifetimes.*

Keywords— *A-DPST, A-DPMST, WSN.*

I. INTRODUCTION

A major technical challenge for WSNs, however, lies in the node energy constraint and its limited computing resources, which may pose a fundamental limit on the network lifetime. Therefore, innovative techniques to eliminate energy inefficiencies that would otherwise shorten the lifetime of the network are highly needed. In many applications of WSNs, data collected by many sensors is based on common phenomena, and hence there is a high probability that this data has some redundancy or correlation.

An aggregation scheme concluded that enhanced network throughput and more potential energy savings are highly possible using data aggregation and in-network processing in sensor networks[1]. Aside from the task of efficient design of data aggregation algorithms, the task of finding and maintaining routes is also nontrivial, especially when it includes the selection of aggregation points and routing through the points. One of the main design goals of WSNs is to carry out data communication while trying to prolong the lifetime of the network and prevent connectivity degradation by employing aggressive energy management techniques.

We are implemented a hierarchical tree-based algorithm is proposed which is completely self-organized and energy efficient with vertex subset degree preserving minimum spanning tree as routing. Sensor nodes are organized into local clusters with one node in each cluster as cluster head. The cluster head receives data from all other sensors in the cluster, aggregates data, and transmits the aggregated data to the BS.

1.1 Routing in Sensor Networks

A new class of spanning trees called Vertex Subset Degree Preserving Spanning Tree (A-DPST) is defined as a spanning tree T of the graph $G(V, E)$ such that $\deg_T(v_i) = \deg G(v_i)$ for all v_i in A which is a nonempty subset of V [4]. The minimum spanning tree problem with an added constraint that the vertices of A should preserve their degrees in the spanning tree which can be termed as A-Degree Preserving Minimum Spanning Tree (A-DPMST). We are using an algorithm for multi-clustering in sensor networks using such A-DPMST is proposed.

The sensor network is considered as a graph whose vertices are the sensors along with the cluster heads, the base station, and the links between them as the edges. Now the collection of cluster heads say A is a nonempty subset of the vertex set of the graph and the construction of the routing tree for the sensor network becomes the problem of finding A-Degree Preserving Spanning Tree in the graph [2]. Because in the sensor network this A-DPST will be a minimally connected sub network in which all the links to the cluster heads are maintained. Since in the tree every other node is either directly connected to the head or having a path to the head, routing will be complete. Such routing could be made optimum by deploying higher energy node as the sensor heads of the clusters.

II. PROPOSED ALGORITHM

One of the important issues in design consideration of a sensor network is nodes lifetime. Our goal is to find solution to this issue. All nodes are given specific grades. All the nodes that can be connected by the sink node can be defined as the 1st-grade nodes, and then the nodes in the 1st-grade nodes' radius are defined as the 2nd-grade nodes[3]. Then divide these nodes in this way, and all nodes will have a certain grade. Our assumption is that the life time of the WSN is until one of the node's energy is consumed completely, so one way to reach the goal is to keep the balance of nodes' residual energy. From, the nodes which are close to the sink node consume more energy and die earlier than others. In order to avoid this we should consider the energy balance of the system when designing the routing algorithm. And thus the WSNs life time is extended.

2.1 Node Weight Assignment

Our routing tree algorithm starts with getting the energy of all nodes and getting the distances of all nodes from the base station and also among the nodes. These distances are given as weights on the corresponding edges[4]. Let E_{bi} denotes the energy of node vi and w_{ij} denotes the distance from node vi to the node vj which is assigned as the weight to the edge joining the nodes vi and vj . Then the procedure get Eligible (w_{bi}) returns the eligible nodes to the set X whose energy is greater than or equal to the threshold value “ t ” which is calculated using the formula, $t = 1/n \sum_{vi \in V} E_{bi}$. Now X is a subset of V the set of all nodes in the network.

2.2 Formation of clusters

For each node v in X we calculate the node weight $w(v)$, using the formula $w(v) = 1/k \sum_{e \in E_v} w(e)$, where E_v denotes the set of all edges having one end vertex as v and $k=|E_v|$. Now the vertices in X are arranged in non decreasing order of their weights. The function addVertex(i) decides whether a node from the sorted eligible set X can be included along with its neighbors to the tree, even after maintaining the disjointness of the clusters and restricting the formation of circuits. The degrees preserving nodes in the routing tree constructed play the role of cluster heads.

2.3 Building a Routing Tree

Our routing tree construction is based on the idea of Kruskal’s algorithm with some modification. The function insert (i) checks whether the sorted remaining nodes can be included in any one of the clusters by means of minimum weight edge without forming any circuit and exclusive of connectivity between the clusters formed[5]. Then, all the cluster heads are attached to the base station and hence a complete routing for the sensor network is obtained.

2.4 After a Transmission

The node from where we want to pass data to the base station is stored in name. Then by using findeligible(name) function we will get all the nodes(Y) which are having an edge with the given node name in the spanning tree.

We can select a particular node from the set of nodes by using the function choose(Y) and energy is reduced from that chosen node. This procedure is continued until we reach the cluster head. Finally from cluster head the data will be transferred to the base station, Then again the tree is constructed.

Algorithm

Procedure Routing Tree(W_{bi} , W_{ij})

/*Initialize all the parameter*/

List $X \leftarrow \Phi$ /* List of eligible nodes*/
 $XX \leftarrow \Phi$ /*List of all nodes*/
 $A \leftarrow \Phi$ /* List of cluster heads in the final tree*/

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T ← Φ /* Final forest whose components
are different clusters*/

E_T ← Φ /* The edge list of the forest T*/
Y ← Φ /*Set of all node connected with a given node
in a spanning tree*/
X ← getEligible(Wbi)
for each v ∈ X
    W(v) = 1/k ∑_{e ∈ E_v} w(e)
end for
X ← sort(X)
for each i ∈ X
    {A, E_T} ← addVertex(i)
end for

R ← E - E_T
R ← sort(R)
for each i ∈ R
    T ← insert (i)
end for
return (A, T)
name=gettext( )
Y=findeligible(name)
choose(Y)
Procedure getEligible(Wbi)
List X ← Φ
t = 1/n ∑_{i=1}^n Ebi
for each vi ∈ V
    {
    if(Ebi >= t)
        X=X ∪ vi
    }
end for
return(x)
Procedure addVertex(i)
List Ei ← edges(i)
for each j ∈ Ei
    if(end node of j is in A)
        return;
    else if(both the end nodes of j are in A)
        return;
    else
        A=A ∪ i
    end for
return (A, Ei)

procedure insert (i)
if (both end nodes of the edge i are in T)
    return;
else if (none of the end nodes of i is in T)
    return;
else
    return i;
procedure findeligible(name)
for each i ∈ XX
    if end node of name is an end node of i
        Y=Y ∪ i
    end if
end for

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return Y
end
procedure choose(Y)
temp=energy(first element in Y)
for each j Y
    if energy j > temp
        reduce_energy(j)
        findeligible(j)
    else
        reduce_energy(temp)
        findeligible(j)
    end if
end for
end
Procedure reduce_energy(i)
for each i
    i=i-10
end for
end
    
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2.5 Description and Complexity Analysis

The algorithm produces a forest first. Initially it includes the node with minimum weight to the cluster head set A and along with its adjacent nodes to T. Then the procedure addVertex (i) includes the other possible head nodes. It never chooses an edge that completes a cycle. Also it will not choose the edge which connects the components already existing. By maintaining these two properties it includes the other nonhead nodes through the procedure insert (i). At each stage the nodes are included to T using possible minimum weight edge. And hence the forest will be almost minimum. To finish all the cluster heads are joined to the base station which completes the routing in the network. Then it returns the routing tree and the set of cluster heads A. The time complexity of the above algorithm is $O(n^2)$.

III. RESULTS AND ANALYSIS

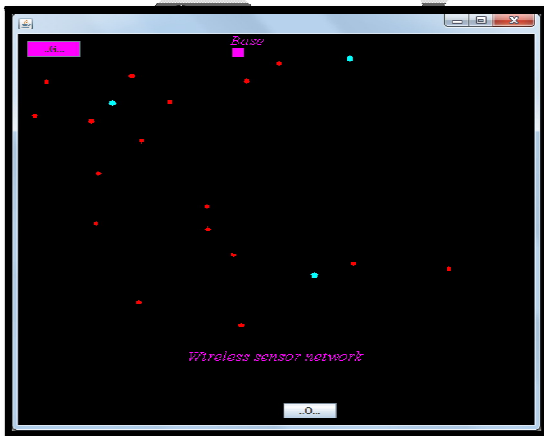


Fig 1: Setting Sensor Nodes Randomly

From fig.1 shows that setting the sensor nodes randomly. Initially assign the sensor nodes to transmit the data packet

from the base station ie. Source to destination. Assigned weight for each node from that which one is going to transmit the data first and do there process accordingly. From fig.2 constructing the graph by using algorithm based, already weight should be assigned for each node. to calculate node weight and arranged non decreasing order. The degrees preserving nodes in the routing tree constructed play the role of cluster heads. From fig.3 constructing the spanning tree it will checks whether the shorted nodes are or not if it is set minimum weight of that node without forming the network.

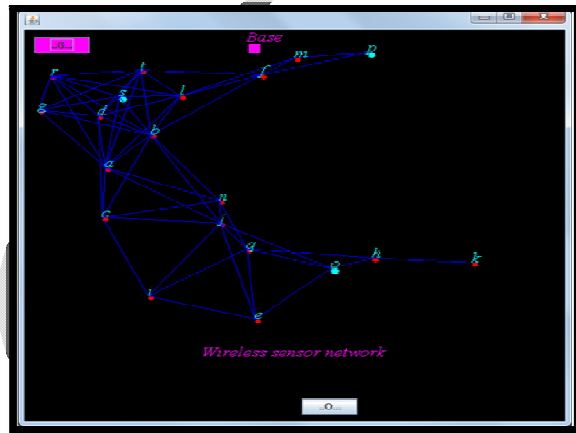


Fig 2 : Constructing Graph

Then where to transfer the data. From fig.4 the spanning tree with given node edge. We can select a particular node from the set of nodes and energy is reduced from that chosen node. we reach the cluster head. Finally from cluster head the data will be transferred to the base station, Then again the tree is constructed.

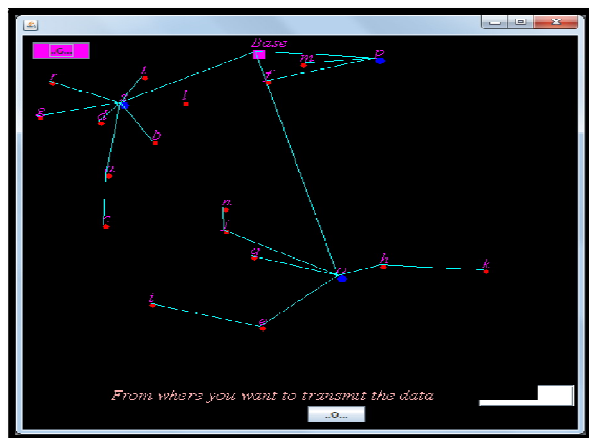


Fig 3: Constructing a Spanning Tree

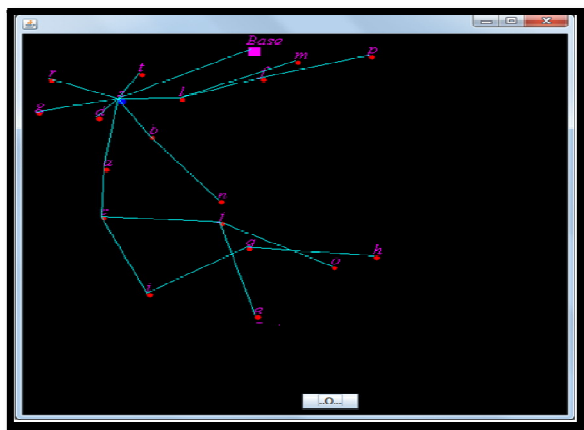


Fig 4: After Transmission of a Spanning Tree

IV. CONCLUSION

A new energy-based routing algorithm using degree preserving spanning tree is proposed for effectively collecting the data in a sensor network. In cluster based routing the sensor nodes transmit data to their cluster heads, which transmit the aggregated data to the base station. In the proposed algorithm, the cluster heads are chosen from the eligible node set which satisfies the condition that their energies are greater than or equal to the threshold value calculated. While forming the clusters also the energies of the nodes are considered and routing could be made optimum by deploying higher energy node as the sensor heads of the clusters. Therefore, the complete routing tree obtained for the network will be almost optimum. We have implemented the algorithm which gives the solution for the problem of multi-cluster formation along with their heads. From this design of the algorithm, the network lifetime is improved.

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