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Life Time Balanced Routing Algorithm for Wireless Sensor Networks

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Abstract: ***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. In sensor networks, it is an important task to periodically collect the data from an area of interest for time-sensitive applications and that data must be gathered and transmitted to a base station. Since the network consists of low-cost nodes with limited battery power, it is a challenging task to design an efficient routing scheme that can minimize delay and offer good performance in energy efficiency, and long network lifetimes.***

Keywords: wsn; grade nodes; date fusion

I. INTRODUCTION

Wireless Sensor Network is a collection of many tiny wireless devices, which are called sensor nodes. The crucial technologies are the energy consumption, Routing Algorithm, and Data-Fusion, which limits the development of the WSNs. Due to the limited energy, extending the life time is one of the vital goals during the designing of the Routing Algorithm, and then energy-balance is the key technology.

II. NODES CLASSIFICATION MODEL

We implemented the algorithm, where all the nodes that can be connected by the sink node can be defined as the *1*st-grade nodes, and then the nodes in the *1*st-grade nodes radius are defined as the *2*nd-grade nodes[1]. Then divide these nodes in this way, and all nodes will have a certain grade. From the given grade node, the data are transferred to the higher grade node until the sink node.

[a] Presentation of the Model

The nodes are divided into two classes, the sink ones and the normal ones, in WSNs. First, some assumption should be given as the following.

1. Nodes are arranged randomly, and the location of them is certain and not changed.
2. The nodes are the same, such as communication radius.
3. The sink nodes will not be limited by the energy.
4. The life time of a WSN is until one of the node's energy is consumed completely.

The sink nodes always lie in the centre of the area on the WSNs, and according to the distance between them. The normal nodes and the sink nodes can be divided into several grades.

Definition : k-Grade nodes

v_i Represents the related node, and R_k represents a set of all k-grade nodes, then we will get the following conclusion,

$v_0 \in R_0$, V_0 is Sink node

$v_i \in R_k$,when $v_j \in R_{k-1}$ and $d(v_i, v_j) \leq d_j$

In the definition, $d(v_i, v_j)$ presents the distance between v_i and v_j , d_j represents the communication radius of v_j.

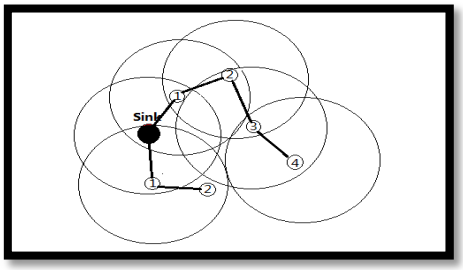

Fig 1: Schematic Diagram of Node Classification

From the above Definition and Figure1, the sink node is at the highest grade. All the nodes that can be connected to the sink node can be defined as the *1*st-grade nodes, and then the nodes in the *1*st-grade nodes radius are defined as the *2*nd-grade nodes. Then divide the other nodes in this way, and all nodes will have a certain grade.

[b] Properties of the Classified-Model

Data are conveyed from the lower grade nodes to the higher grade ones and finally to the sink node. The grades of the nodes can be judged at first after the locations are certain, which will reduce the computing energy. Data are conveyed from the lower grade nodes to the higher grade ones and finally to the sink node.

Property 1: In the classified network, the data from k^{th}- grade nodes can convey to the sink node after at least *k* hops.

Property 2: The data of k^{th} - grade nodes can reach to the sink node only after *k* hops, and then the route is the optimal, where the optimal route represents the route that costs least energy to convey the data.

III. ENERGY BALANCE ALGORITHM DESCRIPTION

[a] Basic Idea of Algorithm

One of the main goals in the routing algorithm in WSNs is to convey data effectively and extend the life time. completely. So one way to reach the goal is to keep the balance of nodes' residual energy. The nodes which are close to the sink node consume more energy and die earlier than others. The life time of a WSN is until one of the node's energy is consumed

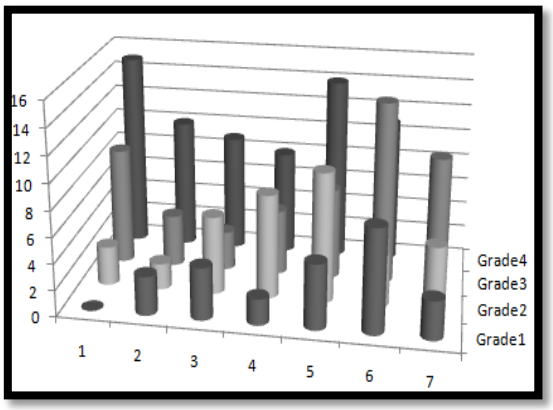

Fig 2: Schematic Diagram of Unbalance Energy

This phenomenon is showed by the *1*st-grade node in Figure 2, whose energy are consumed faster, and this situation contribute to the death of the whole system.

In order to avoid some nodes die of the energy consumption earlier, we should consider the energy balance of the system when designing the routing algorithm. For example, the *1*st-grade nodes have to transmit the data from other node. If these *1*st-

grade nodes can keep balance the residual energy, they will die almost at the same time and the network life time will be extended.

[b] Energy-Consumption Model:

Most energy is consumed by sending and collecting data, while other energy consumption can be omitted.

Node receiving m bits data will consume energy,

$$E_R(m) = m E_{elec}$$

Node sending *m* bits data will also consume energy,

$$E_s(m,d) = m E_{elec} + m E_{amp} d^r$$

Data transmission from nodes V_i and V_j will consume total energy,

$$C_{ij}(m, d_{ij}) = E_R(m) + E_s(m,d)$$

[c] Routing Weight Formula :

To keep the balance of energy when conveying data, algorithms need to get the neighbour nodes residual energy and select the most energy node to sending data. In principle, the next hop node's grade should be higher, but if the energy of the higher-grade nodes is little, we should choose the equal grade nodes or lower grade nodes to sending data. In this way, it may extend the network life time.

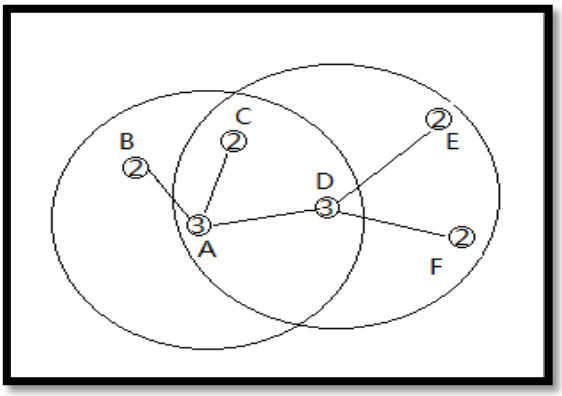

Fig 3: Schematic Diagram of Routing Algorithm

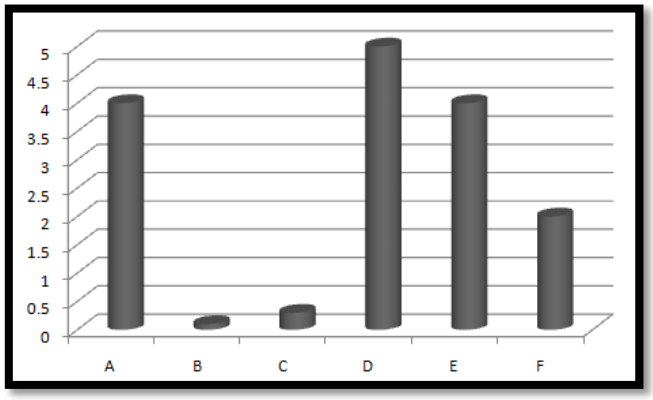

Fig4:Graphical representation Routing Algorithm Each Node

Figure3,and 4 nodes B and C, which are closed to A but have little energy, are not the best choice. However, nodes D, E, F are full of energy, and then sending data to D is better.

The weight coefficient w_{ij} of all the nodes v_j in communication radius of v_i is defined as the following, w_{ij}

In this formula, E_i represents the rest energy of v_i . r_i is the grade. d(v_i ,v_j) is the distance between v_j and v_j , α and β represent the rest energy factor and the distance factor. Then, address these coefficients by the means of normalization, and we can get the possibility p_{ij} to choose the node *j v* as next hop,

[d] Description of the Algorithm

Step 0. Initialize the networks. From the sink node, give all the nodes into certain grades;

Step 1. Assume the data comes from node v_i , whose grade is r_i ;

Step 2. Node v_j receive all the neighbour nodes' information include the residual energy and the distances;

Step 3. Choose the next hop node according to the possibility calculated by the formula (6), where these nodes must meet the requirement $d(v_i, v_j) \leq d_j$ .Then $E_i = E_i - E_s(m,d)$, $E_j = E_j - E_R(m)$.

Step 4. Circulate Step 2 until data reach to the sink node.

From the Property 2, this algorithm is always trying to search for a route which can not only save energy but also balance the rest energy. Moreover, the algorithm will dynamically change the route according to the node energy, so life time will be well increased.

IV. Simulation and Results

In the simulation, assumed the following situations are not taken into account, competition in the channel node, the data packet error, retransmission timeout, signaling transmission, energy consumption calculation.

Only consider the energy consumption of wireless communication. Simulation parameters based on the article [2], specific parameter values in Table 1,

TABLE 1: PARAMETERS

Parameter	Value
Eelec	50(nJ/bit)
Eamp	10(pJ/bit/m2)
Path loss coefficient r	2
Communication radius	80m
Node initial energy E0	1000J
Data of node generate	1Mb
Network-wide	10000m×10000m
Base station location	(5000,5000)

Using the above assumption and parameter values, we constructed the network model and simulated the routing algorithms using java program.

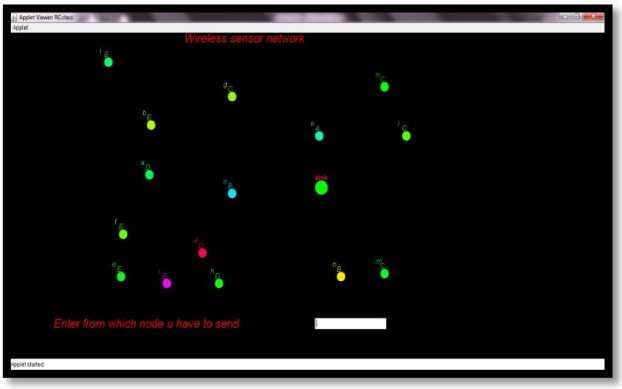

Fig 5: Before Transmission

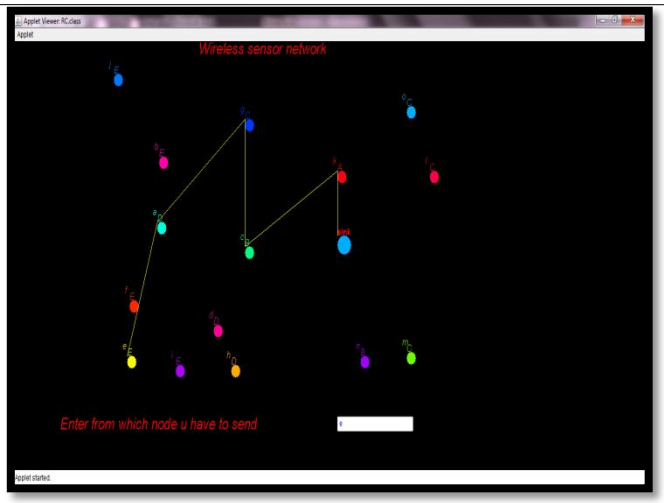

Fig 6: After First Transmission

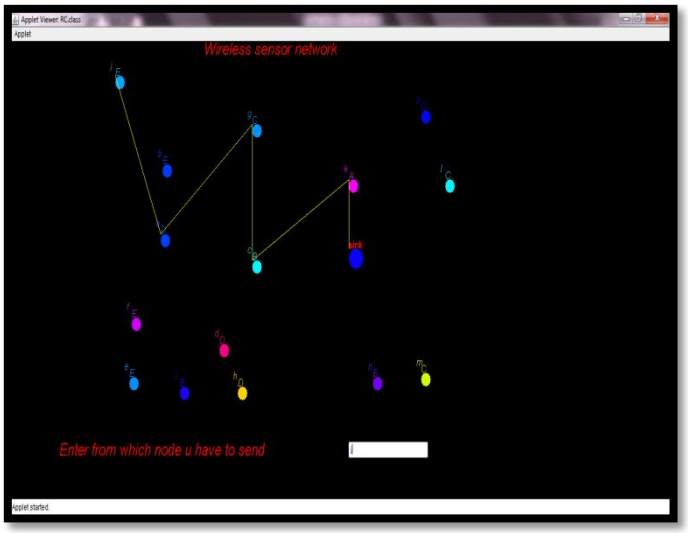

Fig 7: After Second Transmission

V. CONCLUSION

In this paper, we briefed various types of intrusion techniques, need for intrusion detection and the classification of intrusion detection systems is explained. Also the advancements to existing IDS viz. Dynamic Multi-Layer Signature based IDS using Mobile Agents; IDS using parallel technique are discussed. Furthermore effective IDS by ontological linking and knowledge based approach are also discussed.

In Energy balance routing algorithm based on Node classification, the distance of all nodes from sink are established by considering the distance between the normal nodes and the sink nodes. The grades of all the normal nodes are calculated. With the help of the node grades the data conveyed from lower grade nodes to higher grade nodes and finally to the sink node. We have implemented the above algorithms that will always trying to search for a route which can not only save energy but also balance the rest energy. Moreover, the algorithm will dynamically change the route according to the node energy, so life time will be well increased.

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