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Tree Based and Energy Aware Clustering Technique Routing in Wireless Sensor Networks

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Abstract- Wireless Sensor Networks (WSNs) have inherent and unique characteristics rather than traditional networks. They have many different constraints, such as computational power, storage capacity, energy supply and etc; of course the most important issue is their energy constraint. Energy aware routing protocol is very important in WSN, but routing protocol which only considers energy has not efficient performance. Cluster-head election problem is one of the basic Qos requirements of WSNs, yet this problem has not been sufficiently explored in the context of cluster-based sensor networks. Specifically, it is not known how to select the best candidates for the cluster head roles. cluster head and routing tree can be created by using residual energy of the every node in the networks. Nodes have the energy levels when sending the high priority packets in the network loss of energy will create the problem of resending the packets. This will be overcome in this paper by sending high priority packets through the normal nodes and other packets in advanced nodes. Normal nodes have higher energy level when compare to the advanced nodes so, the transmission of high priority packets very fast when compare to other nodes. In this system loss of packets will be reduced. The packets will be differentiated by clustering head in the Network.

Index Terms- Wireless Sensor Networks (WSNs), Clustering, Residual energy

I. INTRODUCTION

Wireless Sensor Networks have been noticed and researched in recent years. These networks are composed of hundreds or thousands of sensor nodes which have many different types of sensors [3]. Wireless Sensor Networks electing Cluster head is most important because electing best head reduce the congestion of packets in the Networks. Each and every node have it own energy called Residual energy i.e,these Residual energy is used to elect the cluster head and formation of routing tree in Networks[7] .We define new algorithm for cluster head election that can better handle heterogeneous energy circumstances than existing clustering algorithms which elect the cluster head only based on a node's own residual energy[8]. After the cluster formation phase,

algorithm constructs a spanning tree over all of the cluster heads. Only the root node of this tree can communicate with the sink node by single-hop communication. Because the energy consumption for all communications in in-network can be computed by the free space model, the energy will be extremely saved, and Network lifetime is extended.. Wireless Sensor Networks can offer unique benefits and versatility with respect to low-power and low-cost rapid deployment for many applications, which do not need human supervision. The nodes in WSNs are usually battery operated sensing devices with limited energy resources and replacing or replenishing the batteries is usually not an option [1]. Thus energy efficiency is one of the most important issues and designing power-efficient protocols is critical for prolonging the lifetime. The latest developments in time critical, low cost, long battery life, and low data rate wireless applications have led to work on WSNs [2]. These WSNs have been considered for work in certain applications with limited power, reliable data transfer, short communication range, and reasonably low cost such as industrial monitoring and control, home automation and security, and automotive sensing applications [3].One of the main reasons for the popularity of Dijkstra's Algorithm is that it is one of the most important and useful algorithms available for generating (exact) optimal solutions to a large class of shortest path problems. The point being that this class of problems is extremely important theoretically, practically, as well as educationally. It will helps to move packet's faster to destination and loss of packet is reduced because, the of lifetime. Then electing energy efficient nodes from nodes in the Networks [5].

II. RELATED WORK

In order to enhance the network lifetime by the period of a particular mission, many routing protocols have been devised. One of these is network clustering, in which network is partitioned into small clusters and each cluster is monitored and controlled by a node, called Cluster Head (CH) and also congestion avoidance can be made . In the sensor network, sensor node can communicate with the base station directly or through the cluster head, or through other relaying nodes. In a direct communication, each node communicates directly with the base station.

When the sensor network is large, the energy for communicating with the base station is correspondingly large. Hence, some nodes far apart from the base station will quickly run out of energy [9]. The other scheme is the clustering; where the nodes are grouped into clusters and one node of the cluster send all gathered data from the nodes in its cluster to the base station. The LEACH (Low energy Adaptive Clustering Hierarchy) is a self-organizing and adaptive clustering protocol that uses randomization to distribute the energy load evenly among the sensor nodes[9], [10]. In the LEACH scheme, the nodes organize themselves into a local cluster and one node behaves as local cluster head. LEACH includes a randomized rotation of the high energy cluster head position such that it rotates among the sensors. This feature leads to a balanced distribution of the energy consumption to all nodes and makes it possible to have a longer lifetime for the entire network. PEGASIS (power-efficient gathering in sensor information systems) [11],[12] is an improvement over LEACH by making only one node transmit data to the base station in this protocol every node transmits it's data only to its nearest/neighbor node in the data fusion phase. These electing cluster heads can communicate directly with the base station (BS). Other nodes send the data, sensed from the environment to these CHs. CHs first aggregate the data from the multiple sensor nodes, and then finally send it directly to the BS. Hence the CH should be powerful, closer to the cluster-censored a less vulnerable. Enterprise Resource Planning (ERP) System implementation is both an art and science that consists of planning, implementation, and ongoing maintenance. This methodology is designed to automate the drudgery of implementation and provide organized approaches to problem solving by listing, diagramming, and documenting all steps. Structured methodologies help to standardize and systemize ERP implementation and maintenance by approaching them as an engineering discipline rather than as whims of individual software developers. It is essential to understand structured methodologies in the implementation of ERP systems. These functions and benefits need to be articulated to ensure that the ERP system performs as desired. This process is called conducting a feasibility analysis. The second feature of integrated systems is that the process of multirecording and transcribing data to update separate records is now replaced by one single input to the computer record. Therefore multiinputs relating to transactions affecting the product are replaced by one single input to the product record held in the computer. Again, imagine the challenges or controls required to facilitate timely coordination and scheduling of all the processes (manual or otherwise) to be undertaken by the different departments so that the single input to the computer system, also referred to as the single point of entry, is accomplished. By the preparation of suitable computer programs (e.g., software, applications, utilities, or combinations thereof) all the information needed by the separate departments can be produced when required. This is accomplished by processing the integrated records held on the Product Master File or in the Integrated Database. Integrated systems thus link together systems that traditionally have been kept separate and, by their very nature, cut across the conventional departmental boundaries that normally exist in a business. The unified nature of an ERP system can lead to significant benefits, including fewer errors, improved speed and efficiency, and more complete access to information. With better access to information, employees and managers can gain a better understanding of what is going on in the enterprise so they make better business decisions. Third step of the process will be electing energy efficient nodes in the Networks. They two types of the nodes in the Network i.e., Normal nodes and advanced nodes. Normal nodes have high energy level but advanced nodes have low energy level in the Network. In this paper packets will be separated high priority packets and low priority packets [6].

III. ARCHITECTURE

A. Overview

In WSNs, ERP protocol helps the data transformation in very efficient manner the most important problem in the networks are electing clustering head and identifying energy efficient nodes. In this system clustering head election will be overcome by using and energy efficient nodes through Enterprise Resource Planning Protocol in the networks . Routing tree will be created in the network by using Dijikstra's Algorithm. This Algorithm will helps to find the minimum shortest distance in the entire network, shortest distance will helps increase the life time of the packets so, the loss of packet in the network will be reduced. Data transformation in the network will through energy efficient nodes i.e. means nodes energy will be calculated.

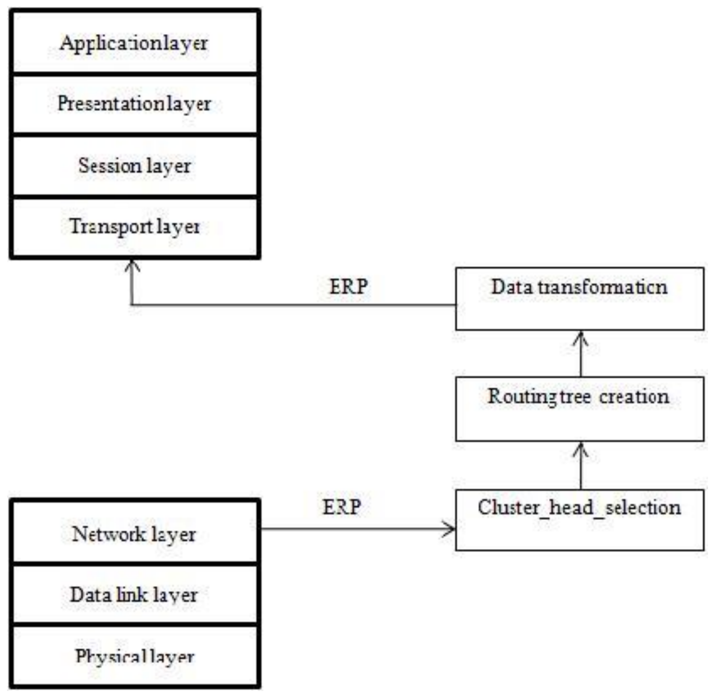


Fig 1: Structure of layered system

After calculating the energy level the packets will send through the network. Before sending packets to data transformation cluster head given priority to packets, priority helps to identify the packets to send energy efficient node or in ordinary nodes.

IV. PROPOSED SYSTEM

A. Tree based Cluster election model

In the set-up phase, each node broadcasts the Node_Residual_Msg within radio range r, which contains residual energy of node. All nodes within the radio range of one node as the neighbors of this node. Each node receives the Node_Residual_Msg from all neighbors in its radio range and updates the neighborhood table and generates CHSV (Cluster Head Selection Value) using Formula 1.

$$CHSV_i = \frac{RE_i}{\sum All\ neighbours\ j\ of\ i(Dis_j)^2}$$

RE_i -- Residual energy of node i.
Dis_j -- Distance from node i to node j.

After clustering, in steady-state phase, cluster heads Broadcast within a radio rang r the Cluster Head Residual Msg which contains node residual energy. The cluster heads compute PSV (Parent Selection Value) by using formula 2.

$$PSV_i = \frac{RE_i}{\sum All\ neighbours\ j\ of\ i\left(\frac{Dis_j}{RE_j}\right)}$$

RE_i -- Residual energy of node i
RE_j -- Residual energy of node j
Dis_j -- Distance from node i to node j

In each cluster heads range, the node has largest PSV selected as parent node and other nodes become child of it, and send the CHILD message to notify the parent node. Finally, after a specified time, a routing tree will be constructed; whose root has the largest PSV among all Cluster heads.

B. Shortest path defining model

Shortest path will be find out by using Dijikstra's Algorithm. The Algorithm has the following steps to finding the shortest path will be:

STEP 1: Initialization

$N=\{s\}$
$D_j = C_{sj}$ for all $j \neq s$
$P_s=0$

STEP 2: For finding the next closest node.

$$D_i = \min_{j \notin N} D_j$$

D_i → current minimum cost from source node to node i.
N → Permanently labeled nodes.

STEP 3: Updating minimum cost after node i added to N. For each node $j \notin N$:

$$D_j = \min\{D_j, D_i + C_{ij}\}$$

Go to step 2.

V. ENERGY EFFICIENT ROUTING IN WIRELESS SENSOR NETWORKS

All proposed clustering techniques in literature, use a cluster head rotation in order to balance the transmission energy cost over the network nodes, because the cluster head role is energy expansive. That permits to grant approximately, the same lifetime until the battery energy depletion. So, in every transmission round, some new nodes play concurrence to be elected as cluster head. Each node selected, has to advertise its status to its neighbor nodes, to know the nodes which will belong to its cluster and to schedule the TDMA intervals [4]. Then, some energy is consumed in this state. This energy for clustering control is considerable, and it is important to reduce this energy to use it to exploit the total network energy to extend the network lifetime.

Table 1. Radio parameter values.

Description	Symbol	Value
Energy consumed by the amplifier to transmit at a shorter distance	ε_{fs}	10pJ/bit/m2
Energy consumed by the amplifier to transmit at a longer distance	ε_{mp}	0.0013pJ/bit/m4
Energy consumed in the electronics circuit to transmit or receive the signal	E_{elec}	50nJ/bit
Energy consumed for beam forming	E_{DA}	5nJ/bit/signal

Our contribution consists in reducing the control energy for cluster formation by keeping each selected cluster head for more than one transmission round. So, each node selected as cluster head, play this role for m consecutive transmission rounds before conceding it for upcoming selection nodes. The proposed algorithm, called Energy Efficient Routing in Wireless Sensor Networks (EERWSN) is a self-organizing, dynamic clustering method that divides dynamically, the network on a number of a priori fixed clusters. Each cluster has one cluster-head. In this work, we use two-level heterogeneous networks, in which there are two types of sensor nodes: the advanced nodes and normal nodes. Let E_0 the initial energy of the normal nodes and, *f* the fraction of the advanced nodes, which own a times more energy than the normal ones. Thus there are *f.N* advanced nodes equipped with initial energy of $(1+a)E_0$ and $(1-f)N$ normal nodes equipped with initial energy of E_0.

We can compute the total initial energy of the networks which is given by:

$$E_{total} = N(1-f)E_0 + Nf(1+a)E_0$$

The node n becomes cluster-head for t_n rounds. In homogenous networks, to guarantee that there are average $P_{opt}N$ Cluster heads every round, ERP let each node n becomes a cluster-head once every $t_n = 1/P_{opt}$ rounds. The network nodes will have different residual energy when Network evolves. If the rotating epoch t_n is the same for all the nodes as proposed in ERP, the energy will be not well distributed and the low-energy nodes will die more quickly than the high-energy nodes. Choose different t_n based on the residual energy $E_n(r)$ of node *n* at round *r*.

The probability threshold that each node *n* use to determine whether itself to become a cluster-head in each round, is given as following Equation:

$$T(n) = \begin{cases} \dfrac{p_n}{\left(1 - p_n.\left(r mod\left(\frac{1}{p_n}\right)\right)\right)}, if\ n \in G \\ 0 \qquad otherwise \end{cases}$$

Where *G* is the set of nodes that are eligible to be cluster heads at round r. If node *n* has not been a cluster-head during the most recent $\frac{1}{p_n}$ rounds, we have $n \in G$. The p_n parameter is given by Equation:

$$p_n = \begin{cases} \dfrac{p_{opt}E_n(r)}{(1+af)\bar{E}(r)} & if\ n\ is\ a\ normal\ node \\ \dfrac{(1+a)p_{opt}E_n(r)}{(1+af)\bar{E}(r)} & if\ n\ is\ an\ advanced\ node \end{cases}$$

where $E_n(r)$ is the residual energy of the node *n* at the round *r* , $\bar{E}(r)$ denotes the average energy of the network at round *r*,which can obtained by

$$\bar{E}(r) = \frac{E_{total}}{N}\left(1 - \frac{r}{R}\right)$$

$$R = \frac{E_{total}}{E_{round}},$$

$$E_{round} = L\left(2NE_{elec} + NE_{DA} + k\varepsilon_{mp}d_{toBS}^4 + N\varepsilon_{mp}d_{toCH}^2\right)$$

k is the number of clusters, E_{DA} is the data aggregation cost which is expended in the cluster-heads, d_{toBS} is the average distance between the cluster head and the base station, and d_{toCH} is the average distance between the cluster members and the cluster-head. If the nodes are uniformly distributed, we can give:

$$d_{toCH} = \frac{M}{\sqrt{2k\pi}}$$

$$d_{toBS} = 0.765\frac{M}{2}$$

From the above Equation, we can find the optimal value *k* of that minimizes E_{round} , which is given by:

$$k_{opt} = \frac{\sqrt{N}}{\sqrt{2\pi}}\frac{\sqrt{\varepsilon_{fs}}}{\sqrt{\varepsilon_{mp}}}\frac{M}{d_{toBS}^2}.$$

This value of *k* is used to determine E_{round} , and therefore, by the above equation each node can find the value of the parameter p_n used in T (*n*) calculation. And, for each round *r*, when node *n* finds it is eligible to be a cluster-head, it will choose a random number between 0 and 1. If the number is less than threshold T (*n*), the node *n* becomes a cluster-head during the current round.

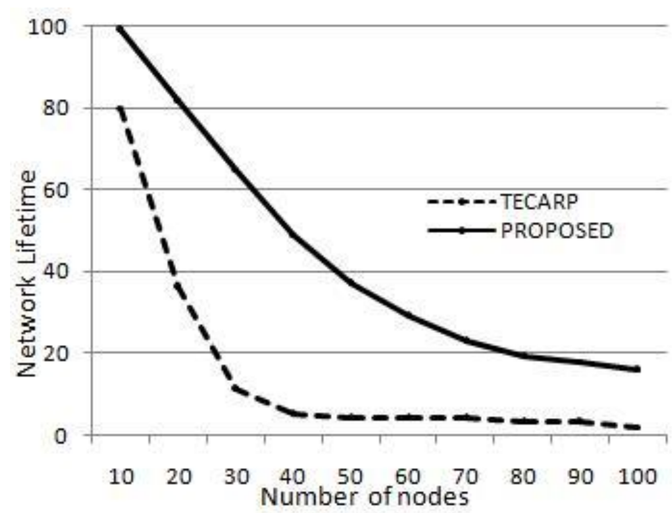
VI. SIMULATION AND RESULTS

The simulation parameters values used in our work are given in the **Table 2**.

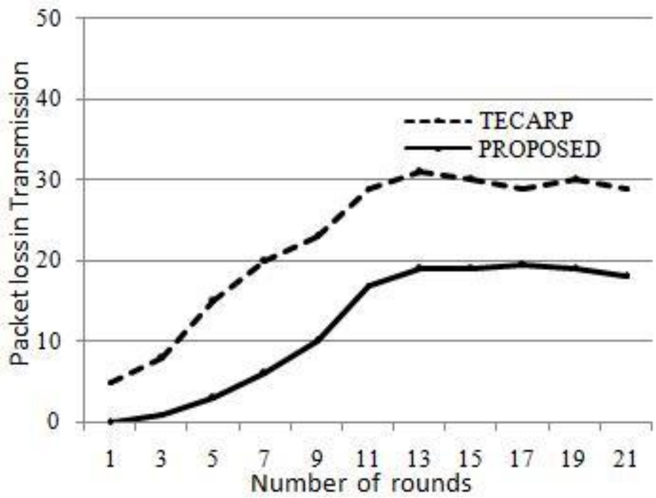
Table 2. Simulation parameter values.

Description	Symbol	Value
Network dimension	*M*	100m
Number of network nodes	*N*	100
Data packet length	*L*	40bits
Control packet length	L_{crt}	20bits
Optimal probability	p_{opt}	0.1
Advanced Nodes percentage	*f*	Variable
Fraction of advanced nodes energy to normal nodes	*a*	Variable

In the Enterprise Resource Planning Protocol the network lifetime also be increased, because of defining shortest path in the network using Dijikstra's algorithm, cluster head and routing tree will created by calculating the Residual energy of the node .It will increase the network lifetime of the Networks, it will shown in the figure.1:



When compare to the TECARP, in ERP protocol loss of packets will be reduced in the network due to using best Clustering head Algorithm. And using Electing Energy Efficient nodes in the entire system it will be shown in the figure.2:



VII. CONCLUSION

In this paper, Cluster head creation and Routing tree will be created by using Residual energy of each node, it will helps to increase the Network lifetime. we have proposed Dijikstra's Algorithm helps to identify the shortest path in the network. Through the simulation, we demonstrate that the proposed algorithm allows a large stable network lifetime compared to the most known Bully Algorithm and Dijikstra's Algorithm in this area. Our future work is based on security.

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