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ENERGY EFFICIENT PROTOCOL FOR WIRELESS SENSOR NETWORKS USING MODIFIED BEE META-HEURISTIC ALGORITHM

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ABSTRACT: Wireless sensor network (WSN) plays a major role in the field of environmental monitoring, military applications, home appliances, and etc. In these applications, the extended lifetime of sensors and Clustering is more required. In the other hand the load balancing sensors is wisely capable of increasing the lifetime of sensors. In this paper, proposed a (MABC) protocol for improving the load balancing in WSN. This protocol is implemented by using three techniques called cluster head selection, cluster formation, and load balancing through improved search area in cluster head selection. The simulated result shows that significant improvement at higher level than the existing protocols.
***KEYWORD*:** cluster head selection, abc, network lifetime.

1. INTRODUCTION

Being a new information exchange as well as control methodology, Wireless Sensor Networks have found numerous applications including military operations, rescue process, monitoring of environment and many others. Wireless sensor networks are a kind of autonomic systems which can be described as collection of several sensor nodes designed to establish communication in hostile environments where human reach is not easily possible. It can easily team up in real time supervising, perceiving along with accumulating details of numerous ecological or maybe monitoring objects and also transfer these details towards the base station. It doesn't demand predetermined system assistance and contains quick employment, survivability as well as other features, therefore it carries an excellent application possibility (Qian Liao, 2013).Ultimately, the data getting sensed through the nodes in the system need to be sent to a control center or base station, where the end-user can easily gain access to the information related to field (Mittal N., march 2010). Wireless sensor networks support multi hop communication i.e. each sensor node forwards its sensed information to a neighborhood node that is near to sink. This process increases the communication overhead on these nodes as a consequence these nodes will die quickly as compared to other nodes resulting in overall failure of the system.

Clustering is the process in which highly dense WSNs are divided into several small groups of sensor nodes, one node among the cluster members acts as a leader called cluster head. These cluster head nodes are responsible for enhancing energy efficiency of system through a process called data aggregation.

The primary goal of data aggregation methods is to eradicate superfluous data transmission and hence improving the lifespan of sensor networks. There are several issues associated with the procedure of clustering a WSN. First is, the number of clusters ought to be formed that may optimize performance of the system. Second might be how numerous nodes ought to be taken into a solitary cluster. Third essential issue may be the selection process of cluster-head inside a cluster (Nandini S PAtil, 2010).

Rest of this paper is arranged as follows: in section II Related works has been discussed followed by proposed algorithm in section III. In section IV results have been discussed and in section V conclusion is given.

2. RELATED WORKS

Wireless Sensor Networks are usually separated into a number of small groups called clusters based on explicit demands of the application. Each cluster has a leader node known as Cluster Head (CH) Node and a number of Member Nodes. Selection of cluster head is generally based on energy level of nodes. Several researchers had worked on clustering problems in WSNs. Typical clustering and cluster based routing protocols for Sensor networks include LEACH, PEGASIS and ABC Algorithm. Here the Artificial Bee colony algorithm is considered.

2.1. LEACH

"Low Energy Adaptive Clustering Hierarchy" (LEACH) (Heinzelman, 2000) is self-organizing and dynamic clustering protocol in which the energy load can be equally distributed between the sensor nodes in the network through randomization. In this clustering protocol nodes belonging to network are divided in several small groups called clusters, every cluster has a leader called cluster head which is responsible for data aggregation and clustering related tasks.

If the selection of cluster-head is fixed during network lifetime as done in conventional clustering protocols, the nodes with lower remaining energy will die quickly due to clustering tasks, resulting in end of lifespan of sensor belonging to that cluster. Hence LEACH utilizes randomized rotation of cluster heads so as to not drain the energy of a single node, which will enhance the total lifespan of the network.

Sensor nodes are elected to be cluster-heads in a particular round based on a probability function p and broadcast their status to all the sensor nodes belonging to network. Based on minimum energy requirement for transmission each sensor node decides to which cluster it desires to join. As cluster-head receives data from all cluster members it will perform data aggregation and forwards aggregated data to base station. In cluster creation process, based on a priori determined percentage each node is elected as cluster head in a particular round.

Each node n selects a random number between 0 and 1 and this number is then compared with threshold $T(n)$ and based on this decision of election of cluster head is done. Threshold value $T(n)$ is calculated for each round from the formula given in equation 1.

$$T(n) = \begin{cases} \frac{P}{1-P*(r \bmod \frac{1}{P})} & if\ n \in G \\ 0 & otherwise \end{cases} \qquad (1)$$

Here P being percentage of clusterheads r is present round and G is set of nodes that have not been elected as clusterhead in last $\frac{1}{P}$ rounds.This threshold T is utilized to elect a node as clusterhead within $\frac{1}{P}$ rounds. In the starting of rounds $(r = 0)$, every node has a probability of being cluster head, nodes elected as cluster head in current rounds cannot be elected as cluster heads for $\frac{1}{P}$ rounds.

2.2. *PEGASIS*

PEGASIS (Power Efficient Gathering System in Sensor Intelligence System) which contains chain formation of nodes produces lesser transmission distance of nodes. At any point of time, only one node will transmit the message to the base station which ends in energy saving (Weinjinget al..2010), Lindsey and Raghavendra (2002)

PEGASIS is the concept of node energy saving rather than hierarchal one. Energy consumption is lesser but load balancing is not uniform Here they focused only on data aggregation than load balancing. so the possibility of dead nodes is higher.

2.3 ARTIFICIAL BEE COLONY ALGORITHM (ABC)

Karaboga (2005) introduced the Artificial Bee colony algorithm. It is based on collective behavior of bees as nector (food source).It consists of three groups of bees: employed bees, onlookers and scouts. Employed bees go to their food source and come back to hive. Once the food has been emptied scouts starts to finding a new food source.

ONLOOKERS WATCH THE DANCES OF EMPLOYED BEES

ABC Algorithm

1: population has to initialize
2: move the employed bees on their food sources
3: move the onlooker bees on the food sources depending on their nectar amounts
4: move the scouts to the search area for discovering new food sources
5: until best solutions are met
6. Update the best position.
7. Terminate.

The algorithm is used to find out the best cluster head selection depends on the fitness function. The best selection set of cluster head has to be proceeded for next round. By using this algorithm cluster head has been selected every round.ABC algorithm provides a improved way of selecting the cluster head but the convergence rate is slow.

3. PROPOSED –MABC IN WSN

3.1 Cluster Head Selection:

Artificial Bee colony algorithm is used to find the cluster heads where each solution represents an array having k item .ABC contains identity of node is to be selected as cluster head for the next round.

$$E = \sum_{i=1}^{m}(P_i^s \cdot t) \qquad (2)$$

$$E \geq \alpha \cdot (\textstyle\sum_i^m d_i^2 + b^2) \cdot t \qquad (3)$$

Where m - number of nodes,
i - Node index,
d_i - Distance between i[th] node and cluster head
b - Distance between cluster-head and the base station,
α - Energy constant
E - transfer energy of the cluster

The sum of energy consumption of the distance is to be mentioned in equation [6] mentioning the cluster energy consumption.

If weight (w) is taken as the multiplication of α and$t$, transfer energy can be calculated as,

$$E \geq w \cdot \textstyle\sum_{j=1}^{n}\left(\sum_{i=1}^{m} d_i^2 + b_j^2\right) \qquad (4)$$

Where j - cluster index
d_{ij} - distance between i[th] node and j[th] cluster-head
b_j - Distance between j[th] cluster-head and the base station.

In the selection process of cluster head, distance between nodes and cluster heads at the same time distance between cluster head and base station is considered. Cluster head have more energy to transfer the message to the base station in the current round, energy levels of normal nodes also participated for the selection of cluster head.

Cluster head should provide energy for transmitting (E^{TX}) to the sink node the and receiving(E^{RX}) from the normal node in cluster. According to (Dorigoel al..1991) expressed the fitness function constraints are given below.

$$f^{CWA} = \left[w \cdot \sum_{j=1}^{n}\left(\sum_{i=1}^{m} d_{ij}^2 + b_j^2\right)\right]^{-1} + \sum_{j}^{n}\left[\frac{b_j^2}{nn_j}\left(EcCH_j\right)\right] \qquad (5)$$

The first part of above equation represents $i, j, E_j, m_j, E_{TX}, E_{RX}, k, E^{elec}, E^{amp}, b, ScE, nn$ are node index, cluster index, energy level of the j^th node, number of nodes in the j^th cluster, transmit energy, receive energy, number of bits of the transmitting message, parameter of radio electronics, parameter of transmit amplifier, and distance value between j^th cluster-head and the base, cluster head energy, number of nodes in each cluster respectively. The second part of above equation concentrated on the residual energy of cluster head selection. Cluster size at greater size should be larger than the clusters nearer to the base station then only the effective load sharing can be achieved.

4. SIMULATION RESULTS

In the simulation study an area of 100x100 meter square has been considered with 100 nodes deployed uniformly. We have simulated the performance of LEACH, SEP, ABC, and Proposed algorithm by observing the load balancing and network lifetime especially.

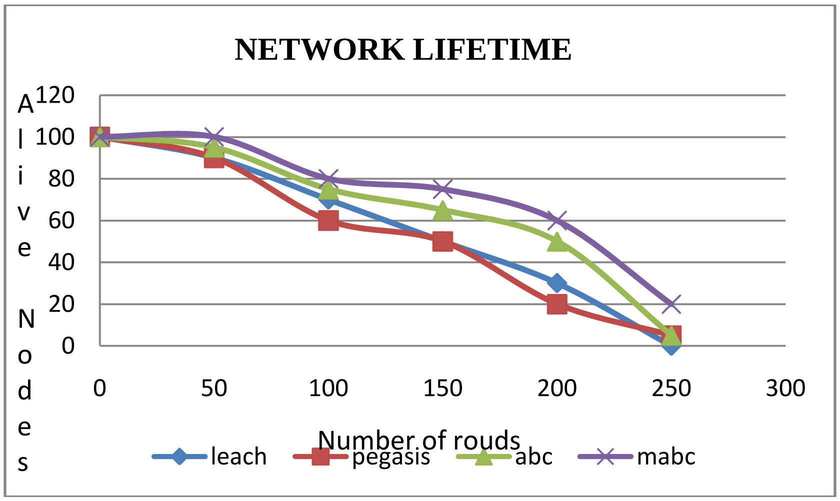

Figure 1: Comparison of network lifetime

Figure 1 shows the network lifetime comparison of various algorithms as simulated in MATLAB. The simulation results show that the proposed algorithm has an improved network lifetime compared to other algorithms.

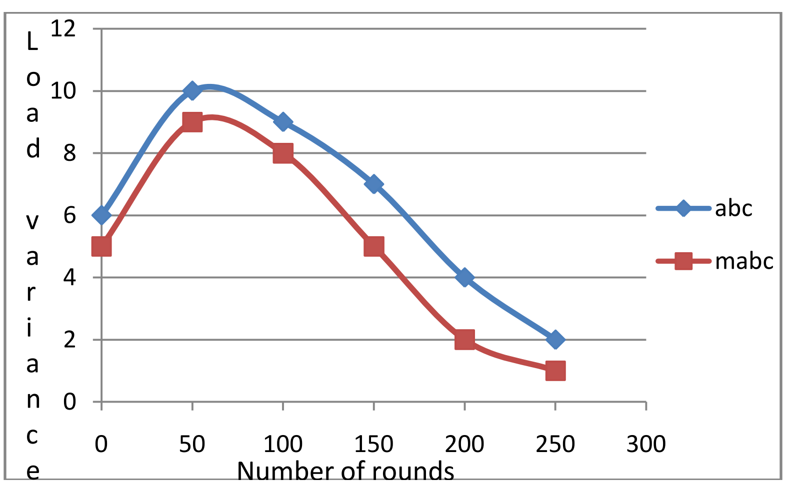

Figure 2: Comparison of load variance between MABC and ABC

Figure 2 shows the comparison of load variance between proposed algorithm and ABC algorithm. The proposed algorithm was nearly 10-15% better in balancing the load between clusters.

5. CONCLUSION:

In this paper, we proposed a novel approach for cluster head selection that uses MABC to enhance the lifetime of sensor networks. Here the cluster head selection is chosen by the optimized fitness function of Modified artificial bee colony algorithm; current cluster head choose the next set of CH_S in every cluster. The simulated result shows that proposed MABC balances the load and enhancing the network life time. MABC protocol performs 20% better at the higher rate than the existing protocols of ABC, PEGASIS and Classical LEACH.

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