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Energy Efficient Packet Transmission-Chain Based Routing Algorithm Using Artificial Bee Colony Approach with Multiple Mobile Sinks in WSN

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ABSTRACT
The wide range of transmission medium is covered by the wireless sensor network. Due to its increasing popularity many research are done to increase its energy level for effective transmission. The earliest approach in transferring packets with prior processing is more efficient which used the concept of Ant Colony Optimisation approach to obtain the chain. This existing Power Energy Gathering with Ant colony approach (PEG-ACO) is efficient in minimising transmission distance but there is no mechanism to find out interrupts in transmission, packet loss due to node failure. This paper proposes routing algorithm artificial bee colony approach which optimises the energy level in nodes. The chain is obtained by clustering the nodes with multiple mobile sinks using Artificial Bee Colony (PEG-ABC) concept in order to avoid node failure and packet lost. The load among the nodes is balanced for effective transmission of packets with less energy consumption.

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Introduction

Innovative data transmission is a challenging issue for researchers in order to improve the efficiency, reduce the energy consumption and improve the life time of sensor nodes in the wireless environment. Wireless Sensor Network (WSN) is an infrastructure based Wireless network made up of multiple tiny sensor nodes (SNs) that sense information from their specific environment and by cooperating with each other, transmit it to a base station [1].

The SNs have the ability to sense data, process it and transmit it. Since they are battery operated, small in size and affordable, they can be practical and useful. The data transmission range of sensor node is limited. To avoid data loss clusters of nodes are formed using algorithm (ABC). The Mobile nodes will collect data from clusters. Instead of using single mobile node multiple mobile nodes can be used to reduce travelling time [2] which in turn saves energy. The node structure is shown in the figure Fig 1

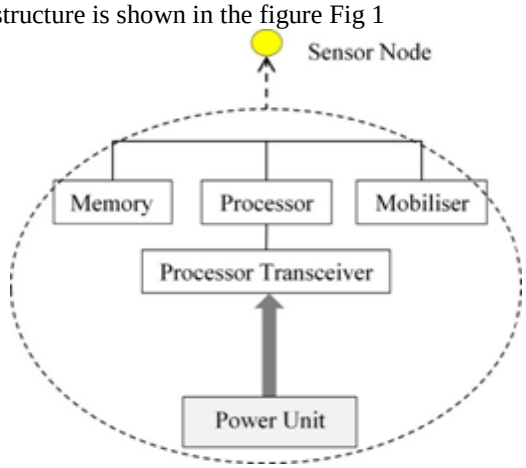

Figure 1. Sensor Node Structure.

In this paper the algorithm proposed Power Energy Gathering using Artificial Bee Colony along with Multiple Mobile Sinks (PEG-ABC) to avoid node failure during transmission. It regulates the packet transmission and saves energy in the nodes. Multiple Mobile sink.s collects the data from cluster heads and transfers it

Related Work

In PEGASIS (Power Energy Gathering in Sensor Information Systems) chain is formed instead of clusters starting from the outmost node from Base Station (BS). The Chain is formed by connecting current node to the nearest node. The data is transmitted through all these nodes to a Chain Leader (CL) which in turn transmits data to BS. This leads to delay of transmission as the data has to go around the nodes to reach CL.

According to Natasha Ramluckun, Vandana Bassoo the PEG-ACO protocol is to combine the benefits of chain-based and cluster-based architectures to reduce overall chain length and decrease transmission distance. It reduces network latency by using simultaneously operating clusters. Achieve proper load balancing in the network by adopting a suitable cluster head technique and Employ an intelligent routing method to obtain globally optimal chain of shortest distance. [1].

Linping et al. [3] have proposed a novel way of increasing efficiency of PEGASIS by selecting two Chain's and dividing the network into different data levels. The scheme elects nodes that are in the proximity of the BS as potential leaders, unlike the random selection of Chain Leader is PEGASIS and hence, reduces transmission distance from Chain Leader to BS. Additionally, a multiple overlapped chain formation technique is applied for transmission of information to Base Station.

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Artificial Bee Colony

Artificial Bee Colony (ABC) is a biological based process of food searching by honey bees. Honey Bees use waggle movement to locate the food and indicate other honey bees about the direction of food.[4]. Artificial Bee Colony (ABC) is an exceptional kind of optimization technique [5] [6] which is highly suitable for finding the adaptive routing for networks.

ABC model consists of three roles of bees: employed bees, onlookers and scouts. These three roles are played by worker bees. The number of employed bees in the colony is equal to the number of food sources around the hive. Employed bees go to their food source and come back to hive and dance on this area. The onlooker bees gather information from employed bees and decide which food source to be selected to gather food. After deciding specific number of bees are put on to work on current food sources. By the time the number of times a food source being avoided without improvement reaches the limit. The employed bee associated with such food sources has been abandoned and becomes a scout and starts to search for finding a new food source.

The exchange of information among bees is the most important process in the formation of collective knowledge. The most important part of the hive is exchanging information in the dancing area. Communication among the bees happens in the dancing area which is formally known as Waggle Dance.

Artificial Bee Colony belongs to group of Swarm Intelligence algorithms and it was proposed by Karaboga in 2005. In this a group of bees called swarm will accomplish the task successfully by intermediate cooperation. In the ABC algorithm, the first half of the swarm consists of employed bees, and the second half constitutes the onlooker bees. The number of employed bees or the onlooker bees is equal to the number of solutions in the swarm.

ABC General Algorithm

The general algorithmic structure of the ABC optimization approach is given as follows [9]:

Initialization begins
REPEAT LOOP
Employed Bees Module
Onlooker Bees Module
Scout Bees Module
Select And Memorize the best solution achieved so far
UNTIL (loop=Maximum Process Number or a Maximum CPU time).

Proposed Routing Algorithm

In this paper proposed algorithm eliminates the node failure and packet loss by finding appropriate chain by clustering the nodes using mobile sinks. PEG-ABC is used to obtain clusters of node with multiple mobile sinks using Artificial Bee Colony algorithm and it has efficient transmission without packet loss when compared to PEG-ACO. The clusters are formed by grouping of the nearby nodes like food foraging by bees and multiple mobile sinks are used to transfer information to base station.

Routing with ABC

The sinks are mobile agents which walk through the network to establish routes between nodes. Route selection uses two bee agents called Employed Bee (EB) and Onlooker Bee (OB). These two bees are similar in structure but differ in the type of work they perform. An EB is an agent, which establishes the path to the source node, and OB establishes path to the destination. An employed bee is broadcast by the sender and relayed by the intermediate nodes till it reaches the destination.

A node receiving an EB for the first time creates a record in its routing table. The record includes destination address, next hop and objective value. The node interprets the source address of the EB as the destination address, the address of the previous node as the next hop and computes the Objective value depending on the number of hops the EB needed to reach the node. Then the node forwards the EB to its neighbours. EB packets have unique sequence number. Duplicate EB is detected through sequence number. Once the duplicate bees are detected, the nodes drop them. When the EB reaches the destination, its information is extracted and it is destroyed. OB is created with same sequence number and sent towards the source. OB reserves the resources at along the nodes towards source. OB establishes path to destination node. [8].

Algorithm 1:

1. N <- Initialize the number of nodes.
2. Evaluate the nodes in three groups, i.e. Employed, Onlooker, Scout Nodes.
3. Loop<- 0, LC<- Loop Count
4. Do
a. For all the employed nodes
i. Establish the path to source node
ii. Broad cast the EB to Nodes
b. For all onlooker nodes
i. Establish the path to destination node
ii. Receives resource from nodes
c. Memorize the best solution for optimal path.

End.

ABC Clustering with mobile Sinks

Clustering is a technique which forms grouping a set of objects into clusters where the objects are of same type within the clusters objects in one cluster should be as dissimilar as possible from objects in other clusters. The energy of the nodes are saved using the method of clustering since a node has to send the data only to the cluster head and not to base station. The cluster head (CH) aggregates the data and pass over to the base station [9].

Clustering has number of advantages such as reducing volume of transmitted data, decreasing the count of nodes which taking part in data transmission, network lifetime prolonged, scalability in large-scale WSNs, communication overhead reduction (for both single and multi-hop communications), delay reduction (than flat networks), load balanced distribution [10]. There are number of clustering protocols for the wireless sensor networks. The algorithm for clustering with multiple mobile sinks is given below

1. Initialize
2. LC <- 0
3. Find out the cluster heads CH
4. Loop Loop +1
5. While Loop <= LC
6. No of Mobile Sink nodes (Msn)=(Cluster Heads (Ch)-1)/2
7. Calculate the distance between cluster heads Dch = Dic-Djc.
8. Divide the clusters equals to number of mobile sink nodes.
9. For Each mobile node Msi
a. Array of Cluster heads An {Ch1,Ch2,…Chn}
b. For i 1 to Cn do
i. If Ai != visited
ii. Ai visited
iii.di data of Chi
iv. End

Very few cluster heads in a network create cluster coverage areas that are too large, requiring excessive energy to transmit data between member nodes and cluster heads

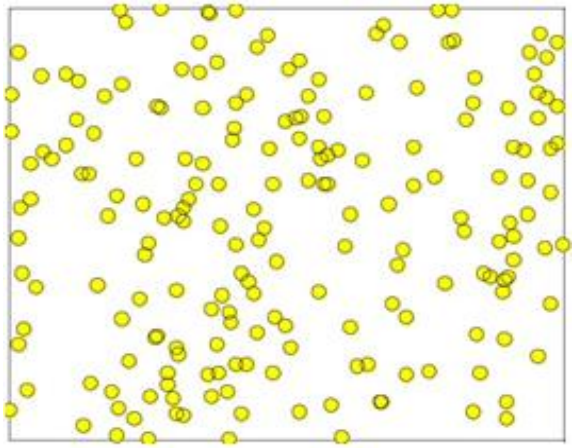
over the greater distance. Conversely, too many cluster heads also lead to excess energy consumption because cluster heads inherently consume much more energy than member nodes. The appropriate number of cluster heads must be chosen to ensure minimum energy consumption throughout the entire network. Hive Header's major responsibility is to claim if any sensor node wants to be CH. CH is chosen on the basis of first declaration. Sensor node which declares in the beginning becomes CH. Other node joins the CH on the basis of RSS.[16]

Energy Efficient Routing with ABC

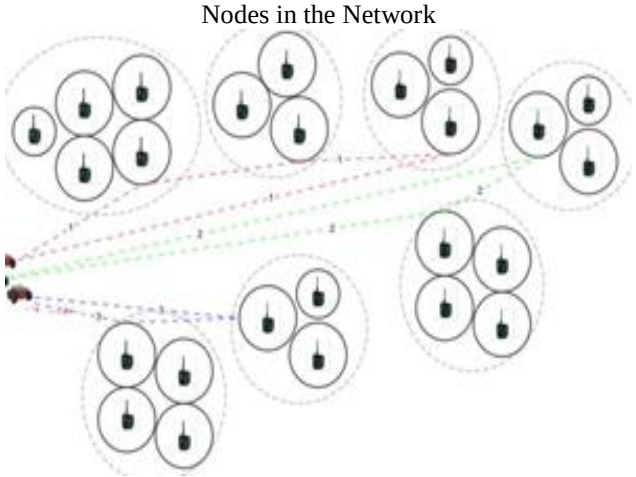
The chain is formed by connecting all the cluster heads CH through mobile sinks. The distance is calculated using Dch = Dic-Djc. The multiple mobile sinks collect the data from CH and transfer it to base or destination according to the address in packets. Node will data to CH alone CH will transfer it to the nearest MMS(Multiple Mobile Sink). [20]

The total residual energy of nodes is an indicative of the remaining overall energy of the network. It is the sum of all energies of alive nodes and is measured during each communication round. Figure shows the simulation results obtained for residual energy

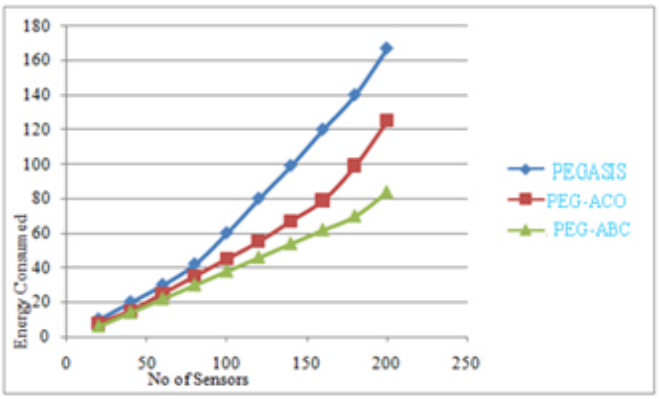
For a network of 200 m 200 m, containing 100 nodes. As demonstrated by results from Fig. 11, both clustering methods outperforms PEG-ACO with regards to residual energy of network but Horizontal PEG-ACO Clustering has higher residual energy throughout the entire network lifetime. This is due to minimisation of transmission distance to BS by using nodes present in the highest level cluster. There is a gradual increase in the highest level CH to BS transmission distance when a cluster dies since the next highest level cluster takes the charge of electing the CH to transmit to the BS. Due to this progressive increase in distance, transmission energy increases PEG-ABC Clustering with mobile sinks.



Nodes in the Network



Clusters with Chain



Energy Consumption of PEG-ABC

Conclusion and Future Work

The PEG-ABC algorithm with multiple mobile sinks overcomes the node failure by identifying cluster heads and transfers the information through mobile sinks to the base station. In our proposed work the nodes are clustered and mobile sinks along the chain will collect data from the cluster heads. As the nodes sent the data to cluster heads alone maximum energy is saved. The ABC follows three bees for food hunting and storing. The proposed algorithm uses multiple mobile sinks for finding information, collecting, storing address and transmitting it to proper destination. As the energy is saved node failure is avoided and loss of packet due to node failure is also avoided. Here Multiple mobile sinks used to carry packets. A more effective algorithm can be used to simulate the flow of mobile sinks to attain more effective transmission of packets. Simulators like NS2 can be used for efficient use of multiple mobile sinks.

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