Improved Clustering with Optimization and Intelligent Path Selection

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Abstract: Wireless sensor networks (WSN) are widely used networking paradigm in research areas and clustering is one of the trusted mechanism for storing and processing data among the nodes in the network. The clustering makes use of a single node for transferring data to the sink node with sustaining the energy of all other nodes in the network and does the procedure of storing and processing of data using an optimization technique called as Ant Colony Optimization (ACO). The ACO is proposed in accordance along clustering which is the optimization technique used for robust communication between source node and destination node. The clustering mechanism used for sending data along the best path among the source and destination in the network so that the data can reach the destination rapidly and that helps in availing the faster response between source node and destination node. The ACO will greatly influence the dropped packets and that the delay occurring in the network based on the traffic available among the nodes in the network.

Keywords: Ant Colony Optimization (ACO) Clustering, Optimization, Wireless Sensor Networks (WSN).

I. INTRODUCTION

Wireless sensor network is one of the categories of networks where sensor nodes used to collect the data from the field of area to be monitored. The data can be stored and communicated to any of the nodes in the network. The smaller size of sensor in WSN is an added benefit to move along easily and gather information about the monitored target field. The wireless network structure has been used to gather data from anywhere and send it to the base station. The main problem that affects sensor networks is the limited battery power, idle state of the sensor and mobility of the sensor networks.

The optimization technique have been proposed to improve the power source of the sensor such as clustering which has considerably increased the performance of the network by limiting the idle state of the sensor node and the load factor of sensor node. [11] These factors together have been considered to increase the efficiency of the sensor network.

II. CLUSTERING

In wireless sensor network, data are being gathered, processed and transferred to the base station but most of the sensor node loses its power during the transferring of data between nodes and to the base station [1].

The network may contain some sensor nodes to be heavily loaded and their battery sources are drained quickly and in the counterpart most of the nodes are in idle state during communications between some nodes. To resolve these issues occurring during the transactions clustering method is introduced. In clustering method data are grouped as cluster based on the node availability and its location. For each cluster a node is allocated as Cluster Head (CH) and all other nodes in the network are participating nodes in the cluster are assigned as Cluster Members (CM). [6] The role of the CH is to collect the data from the CM and process the information and then to transfer it to the base station by using clustering method. [4] The work load of the entire CM is reduced since the major work is being done by CH itself. The CH is changed for each round in an unbalanced manner. [5] The existing clustering mechanism does not provide an effective method of electing CH and this leads to prevailing of unbalanced clusters. To overcome this setback, efficient methods are proposed to improve the clustering mechanism and to maintain the overall balance of the network with help of balanced CH selection. The optimal usage of residual energy is considered as the primary factor for selecting CH and distance between head and sink node are also taken into account to select the best CH which leads to reduced CH load and the lifetime of CH is also increased significantly.

III. ANT COLONY OPTIMIZATION

Optimization is considered to be very vital with regard to data storage and data gathering with respect to WSN. [10] Among the various optimization techniques used in sensor network, the ACO is one of the most trusted technique. The ACO technique uses the model of ant movement and the path utilized by the ant is used to predict the best path between the source and destination [2]. The data can travel to the sink node by using the substance called as pheromone in the path utilized by ant which they travel. The ant always uses the shortest and best path to travel from source to destination. [9] The path which provides higher pheromone index is the best path because most of the ant has followed the corresponding path to reach the destination from the source. To achieve experimental results, the pheromone index value is deployed in each node to identify the best path for the data that can travel to reach the required target node without any delay or loss of packets.

IV. PROPOSED APPROACH

In clustering, the majority of tasks are completed by the CH.

The existing weighted clustering algorithm in which each node is allocated with particular weight and the node with least weight is elected as CH, further more in each round the weight of the node varies so it's obvious that the CH selection should be done at the end of each and every round. To avoid this kind of bottle neck the best practice is to be followed to elect the correct CH.

The technique proposed towards CH selection is to reduce the occurrence of election process by retaining the same CH for N number of rounds. The load factor of CH should be reduced and the data transferring could be done optimally to increase the life time of network and increase the energy of the network. The CH can be selected based on the calculated CH value using the formula,

CH= f1 (N1) + f2 (N1) + f3 (N1) + ….. + fn (N1)

Value of CH is calculated using different functions such as,
1. Residual energy of the node
2. Distance between said to be CH and SN
3. Distance between said to be CH and CM
4. Energy consumed for node in each round

Based on the different functions and their values the best node will be elected as CH, all participating node in the cluster will disseminate all the above mentioned function values with the CM. The selected node will consider itself as a CH and will treat the remaining node as CM and calculate the following data and forward it to the remaining nodes. After obtaining all the values from each node the least of CH value will be made as head for all the rounds in the clustering and the cycle continues in each and every round. At the end of every cycle, the value is determined so that the first selected node can act as CH or in the subsequent rounds the CH can be changed based on their value.

Once after the cluster are being formed the role of cluster is to collect the data and transmit data to the sink node, in transmission phase the ACO takes the advantage of route selection, by utilizing the pheromone index to find the best path for the data to travel between two nodes so that the time taken to pass through from source to destination is reduced to a higher extent.

Table 1.Proposed Algorithm for Improved Clustering and Ant Colony Optimization (ICACO)

Initialize all nodes
Elect the CH
For each node i calculate
Residual energy of the node
Distance between said to be CH and SN (DSN)
Distance between said to be CH and CM (DCM)
Energy consumed for node in each round
If Max (RE) & Min (DSN & DCM)
CH=Node (i)
CM=Neighbours node (CH)
End
Initialize pheromone index for every node
Update pheromone (each round)
If(CM-Max (Pher)> (CM-First(Pher))

Choose the Max(Pher) path

  Store path (Max(Pher))

   Continue

End

End

V.   RESULTS ANALYSIS

The proposed algorithm for Improved Clustering and Ant Colony Optimization (ICACO) used for intelligent path selection is being compared with traditional clustering mechanism for transferring data with the base station, the results are discussed below with respect to throughput, delay, dropped packets and life time of the network is analyzed. There has been considerable increase in the performance of the algorithm in all the area of comparison the overall quality of the network is improved by using ACO in addition to optimized clustering for transferring data.

The following parameters are used in creating the test and comparing the performance of the proposed algorithm.

Table 2.Simulation parameters for algorithm

PARAMETERS	VALUE
Version	Ns-all-in-one 3.20
Propagation Model	Two Ray Ground
Area	1500m x 1500m
Broadcast Area	50-100 m
Transfer Pattern	User Datagram Protocol
Mobility Model	Random Mobility
Transfer per Packet	1024 bytes

A. Throughput

The graph shows that there is increase in the overall packet transferred between source node and sink node.
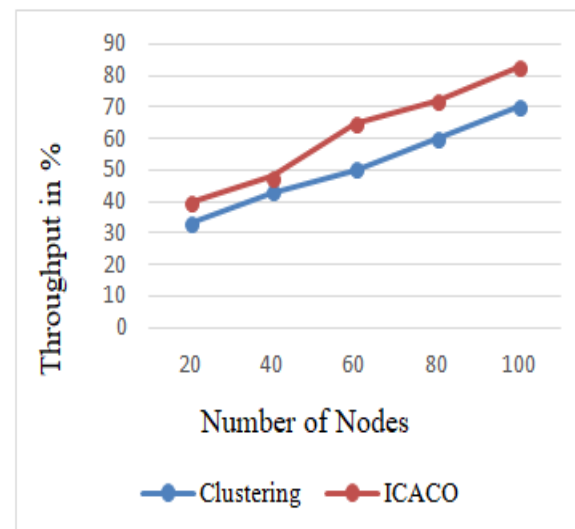
Fig. 1. Throughput

B. Delay

The graph depicts the overall delay in sending and receiving of packets encountered at the end of every round and the final delay is also represented.
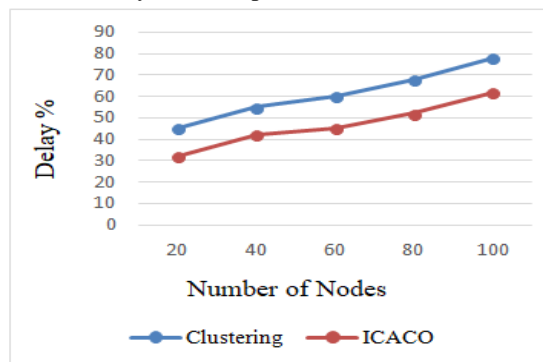

Fig. 2. Delay

C. Dropped Packets

Packets dropping significantly influence the performance of the network. If a node drops the packet it has to resend the packet to the same destination but this will increase the overhead on both the nodes. There is decreased overhead occurred in both source and destination in the proposed method by reducing the number of packets are reduced.
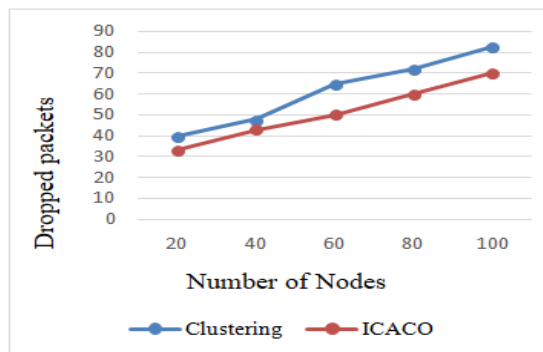

Fig. 3. Dropped packets

D. Life time of network

Life time of the network depends upon several parameters such as number of CH elected in each and every round and the energy available for each node at end of a transferring of data. The graph dictates the life time of the network at the end of overall data transmission are complete.
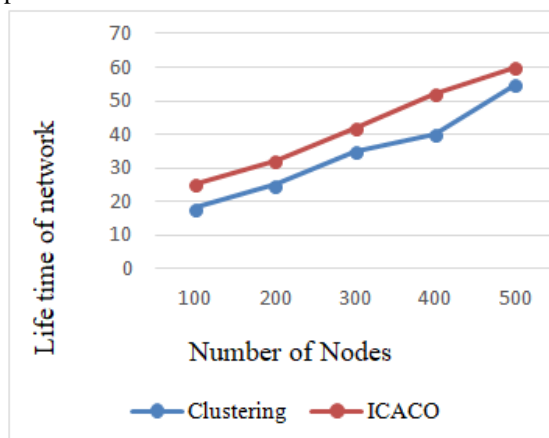

Fig. 4. Life time of network

VI.   CONCLUSION

The proposed algorithm for optimized cluster formation and data transfer through best path selection has increased the overall performance of the network to a greater extent which is evident in the experimental results. After the cluster formation is performed the data are transferred using the ACO mechanism which by means of the best path selection for the data traversal in trusted network the dropped packets are also reduced. In addition to the above mentioned algorithm clustering mechanism could be improved with introducing more parameters in choosing better CH and its corresponding cluster members. The process of retaining the CH for more than one round of data transfer enables the CH node to sustain its energy throughout the communication to the sink node.

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Ms.J.Deepika, is employed as an Assistant Professor in the Department of Information Technology at Sona College of Technology with eight years of experience in teaching. She has completed master's degree in computer science and engineering and bachelor's degree in information technology. She has published around five research articles in refereed journals. Her current research area focus on wireless sensor networks, machine learning and swarm intelligence.