IMPROVED BAT ALGORITHM BASED CLUSTERING IN WSN

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ABSTRACT
Clustering in wireless sensor network is an important aspect of research in wireless networks. Clusters in the network can be formed on the basis of either geographical area of the nodes or on the basis of some performance parameters. Also the nodes which form the cluster are either homogenous or heterogeneous in nature. In the proposed approach an objective function is proposed and and the objective function is used for the implementation of Bat Algorithm. The distance between nodes is computed using the Bat Algorithm. The distance is then used for clustering in the network. The results of the proposed approach are then compared with the basic algorithm. The results also verify the algorithm and compared on the basis of performance parameters like residual energy, end to end delay and throughput of the network. In the future other machine learning must be implemented and compared with the existing approach.
Keywords: Clustering, WSN, Bat Algorithm

INTRODUCTION

In WSN, sensor nodes are required with limited energy resources. The major goal of WSN is to gather the information efficiently [1]. These are wireless sensor networks are used in various field such as industrial and consumer applications (precision agriculture, machine health monitoring, etc), military applications (aircraft control, marine environment monitoring) etc. The whole network of wireless sensor network must have capability to work in very ruthless environments. In harsh condition, WSN can't be easily scheduled or efficiently managed. Also in this type of condition, network was not feasible at all [2]. Moreover, wireless sensor is energy constrained in these ruthless conditions and their batteries generally not recharged.

Clustering is the process which divides the network into interconnect substructure called clusters [3]. Every cluster has cluster head which act as coordinator within substructure. Cluster head acting as medium for transferring data in between the nodes. CH communicates with each other by using gateway nodes. Clustering is one of the most popular unsupervised learning techniques (i.e. used for connecting the causative gap between input and output observation) [4]. Clustering is "the process of organizing objects into groups whose members are similar in some ways". Basically, clustering is to find the internal set of unlabeled information. In clustering, we organize the information in the form of packets or we can say into clusters. Nodes are gathered to form cluster with the cluster head which has the liability of routing from one cluster to other cluster head or base station [5]. Data is travelling from lower layer of cluster to higher layer.

Literature Survey

In this paper, Bahmani-Firouzi et al. [1], proposed Dynamic Source routing algorithm. This proposed algorithm is same as data based routing. This algorithm uses a formal logic utilization based system in order to calculate the nodes. These calculated nodes must have to forward a packet to the neighboring node should maintain the gap and angle between two neighboring detector nodes. The result of the proposed algorithm indicates that proposed method has an identical packet delivery magnitude with very less energy consumption.

Ortiz, Antonio M. et al [2] in this paper, the consequences of the variations between the underwater and terrestrial transmission mediums has been presented. Moreover, the relationship between energy consumption on totally different radio modes has also been presented. They approach a set of recent routing protocols considering factors like water depth and temperature.

Alihodzic, et al. [3] proposed the general underwater sensor network architecture with their sink placed on the surface of water. A packet in the data based routing involves an area which stores the data of its last forwarder and is updated at every hop.

Salvador Climent et al. [4] proposed EDETA-e (Energy-efficient adaptive graded and robust design enhanced). The proposed EDETA approach is one of the power-aware routing protocol which helps to reduce the consumption of energy. It allocate the nodes in clusters and uses low power modes. Furthermore, the proposed approach provides fault tolerant mechanisms and has time constrained properties.

Seokhoon Yoon [5] proposed the AURP to address the matter of low packet delivery magnitude relation and high energy consumption in an exceedingly multi-hop Underwater Acoustic detector Network. AURP develops controlled quality of multiple Autonomous Underwater Vehicles alike to heterogeneous acoustic communication channels in order to recognize high data delivery magnitude relation. Moreover, proposed protocol provides low consumption of energy.

Wang, Sheng-Shih et al. [6] proposed QELAR (Q-learning-based Routing) in this paper. This approach is depends on associate degree accommodative, energy-efficient, and lifetime aware routing protocol supported reinforcement learning. QELAR protocol suppose the generic MAC protocols.

Yilmaz, Selim [7], proposed SP-power routing formula that provides the energy dissipation through a link as metric. Furthermore, a SP-cost routing has been presented and finally proposed a SP-power-cost routing, so as to optimize a mix of energy dissipation and remaining energy state cost.
Zhao, Miao et al. [8] proposed a link metric which mixes the transmission energy quantity, the reception energy quantity, the initial energy state and the remaining energy state of each supply node and therefore destination node. The distributed Bellman- Ford formula was employed in order to build the SPT supported outlined metric.

PROPOSED METHODOLOGY

An objective function is proposed on the basis of parameters depicted below:

- Residual Energy of the network: Residual Energy is an important factor in calculating the network lifetime of a node in the network. The energy exhausted by the node in communicating from other nodes or the in idle mode is used. Residual energy is

$$Residual\ Energy = Total\ Energy - Energy\ used$$

- Distance between the Nodes: Distance between two nodes communicating with each other at a particular time is calculated. The distance is an important factor as the energy consumed in transmitting a packet directly depends on the distance between the nodes. Distance is calculated using the Euclidean Formula which is given by:

$$Distance = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

- Normalized Packet Loss Rate: The packet lost while transferring packets from one node to another is also an important factor in detection of congestion. The packets lost in the network are due to mainly two reasons, the first one is the queue length of the node and the second reason is the packet collision in the network. The packet loss rate must be minimized for improving the performance of the congestion detection and control algorithm.

$$Objective\ Function = \sqrt{(w_1 * P_L + w_2 * R_E + w_3 * d_{ij})}$$

$where\ w_1, w_2\ and\ w_3\ are\ weights\ which\ satisfy\ the\ equation$

$w_1 + w_2 + w_3 = 1$

$and\ P_L\ is\ the\ packets\ lost\ ,$

$R_E\ is\ the\ residual\ energy\ and\ d_{ij}\ is\ the\ distance\ between\ nodes$

Based on the value of the objective function the bio inspired bat algorithm is used for the calculation of the distance between the nodes in the network.

Bat Algorithm: Mostly, the bat are using the echolocation to some definite degree. For example, micro bats are used example echolocation but mega bats do not use echolocation. Micro bats used types of the sonar is called the echolocation, to detect prey, avoid obstacles, and locate their roosting crevices in the dark.

For simplicity, in our approach, the following approximate or idealized rules were used:

1) All bats use echolocation to sense distance, and they also 'know' the difference between food/prey and background barriers in some magical way;

2) Bats fly randomly with velocity v_i at position x_i with a frequency $f_{\min}$, varying wavelength λ and loudness A_0 to search for prey. They can automatically adjust the wavelength (or frequency) of their emitted pulses and adjust the rate of pulse emission r [0, 1], depending on the proximity of their target;

3) Although the loudness can vary in many ways, we assume that the loudness varies from a large (positive) A_0 to a minimum constant value $A_{\min}$.

RESULTS AND DISCUSSIONS

Figure 1 shows the average energy consumed in the network. The figure shows the comparison of the basic and the proposed bat algorithm approach. The average energy consumed is more in case of the basic approach. Figure 2 shows the Throughput of the network and in figure 3 the end to end delay is plotted against the simulation time. The throughput and the end to end delay of eth network is improved in case of proposed approach because the packets loss in the network is reduced as compared to the basic approach.

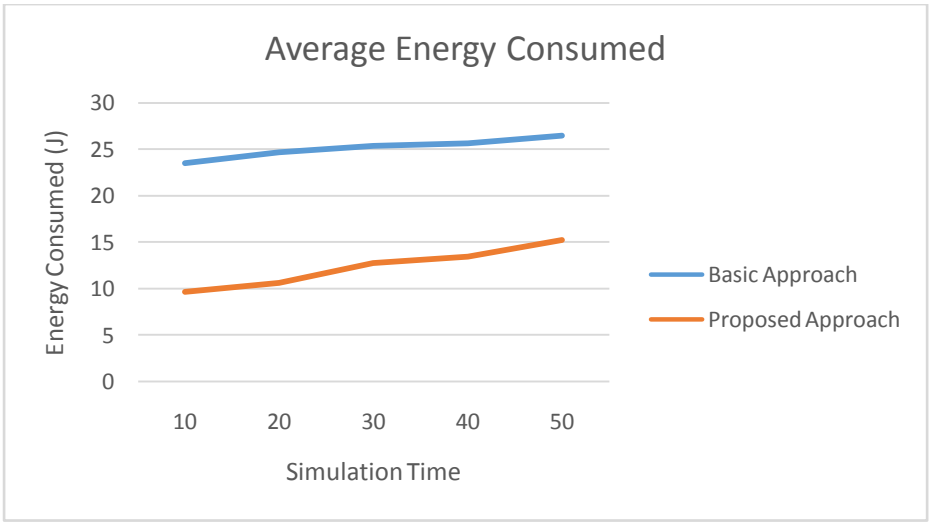

Fig 1 Energy Consumed in the Network

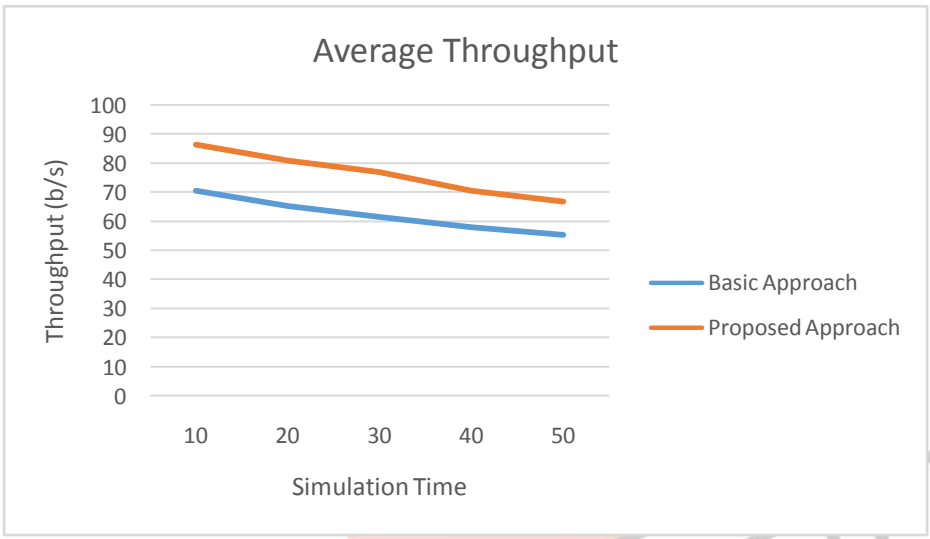

Fig 2 Throughput of the Network

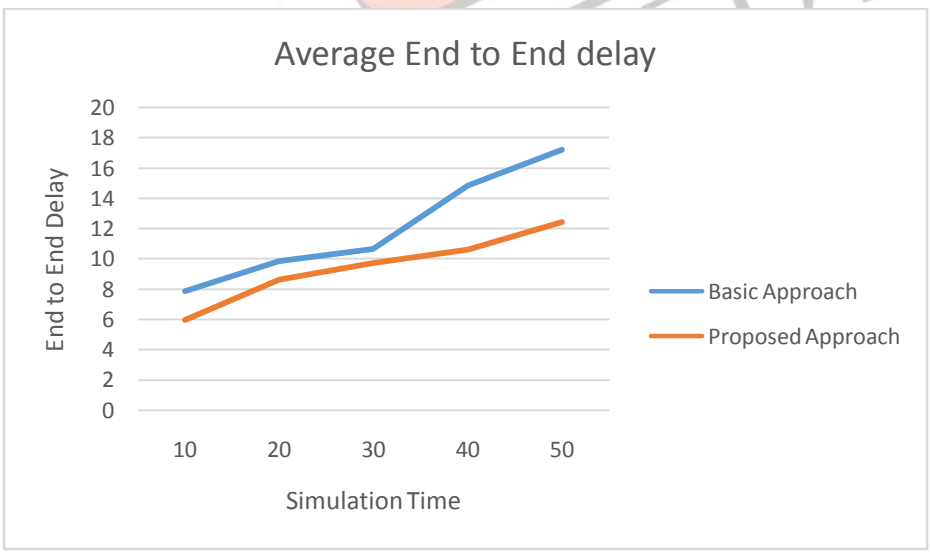

Fig 3 End to End Delay

CONCLUSION

Clustering is the most basic operation of research in WSN. It is an important issue of concern in recent years. Many approaches are proposed by the researchers in recent times which uses the clustering an important addition in the network from the point of view of energy consumption. In the present work Bat Algorithm is used for clustering in the network. It is a recursive process which uses iterative steps to performs the computation. The objective function value is calculated for each node in the network and bat algorithm is used for the calculation of distance and the local best after each iteration. The results also show that the proposed approach outperforms the basic approach on the basis of various performance parameters like residual energy, end to end delay and the packet delivery ratio.

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