A NOVEL ENERGY EFFICIENT RELAY NODE PLACEMENT APPROACH FOR WSN

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ABSTRACT

Partitioning in wireless sensor network is an important aspect of research in wireless networks. Clusters or partitions 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 relay nodes are placed in the network on the basis of the value of objective function. The results of the proposed approach are then compared with the CRAFT algorithm which uses polygon approach for placing the ferry nodes. The results also verify the algorithm and compared on the basis of performance parameters like residual energy, end to end delay and number of hops in the network. In the future machine learning must be implemented and compared with the existing approach.

Keywords: Partitioning, WSN, Ferry Nodes

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.

Wireless Sensor Network is the most growing industries for research nowadays. With the betterment in technology and growth of industries, many consider WSN as the basic requirement for setting up the industries. The sensors are placed everywhere in the industry to retreive live data and to take correct decisions [3]. Wireless sensor networks are the sensors arranged in various monitoring environments which are managed by a central receiving unit called Base Station. Base Station is liable for the collection and processing of data collected from various distinct kinds of sensors. These sensors in the network are categorized as the heterogeneous and homogenous sensors. The sensors setup in the network is either the same type of sensors or of different kind relies on the application [4]. In the various applications for military and police investigation Wireless sensor networks can be used. Various developments within the hardware minimize the less-cost production or development in wireless communications technologies that have created probably various applications with the high numbers of sensors. In some another cases, the main purpose of the access

space must be checked and thus a result to be Set up the sensor to locate then from craft network. When the positions are not located, the only way to contribute enough target coverage by sensors in order to use multiple sensors than the fastened variety [5]. After the placement of the sensors in the network the second and the most important part is clustering. Clustering of the sensors in the network is either which is fixed and usually depends on the geographical location of the network or it is dynamic means the nodes in each cluster are dynamically distributed and there is some algorithm for the selection of the nodes in the cluster. The algorithm must either be energy efficient or bandwidth efficient or both [6]. Figure 1 shows the system model of WSN Network. There is commonly a basic problem in sensing networks which is named network lifespan. To keep the technology, the sensors area units are hopped-up with the battery [7]. The value and size constraints offer energy within the detector to sense the communication and globally have an effect on the lifespan of the node.

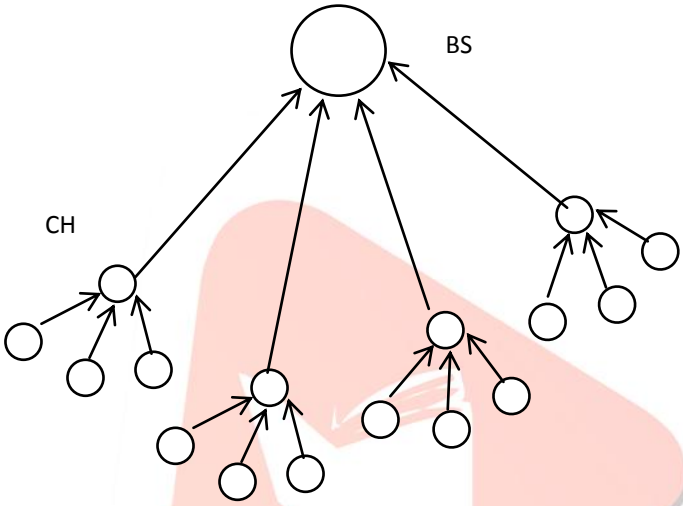

Fig 1 WSN Architecture

LITERATURE REVIEW

Gholami et al. (2013) [1] presented the scheme which is used to resolve the issue of localization and optimum placement of wireless sensors in the network. In order to locate the optimum location, Neural based approaches has been used. In these neural approaches, the sensors should be located to provide better results in terms of enhancement in effectiveness andprecision.

Gong Bencan and XuShouzhi (2013) [2] proposed an unequal density based node deployment clustering (UDNDC). In this nodes are deployed in different areas which depend on load for data forwarding, therefore extra energy is given to nodes for data forwarding early energy drain of some nodes. Simulation results shows that the proposed algorithm increase the network lifetime and perform better than LEACH-C and HEED.

In this thesis, **Mostafa, Baghouri et al. (2013) [3]** proposed that WSN is group of nodes in the terms of storage, computing and power. In this network, few nodes have become cluster head thus the behaviour of sensor network becomes unstable as soon as the life of first node is elapsed. Stable Election Protocol proposed extension of time to the network stability before death of first node and reduction of the unstable time before death of last node. This protocol has based on election of the cluster head by balance of probabilities of remaining energy for each node. In this author proposed to improve the SEP by fuzzy logic. We display the simulation in MATLAB that increases the stability

period or decreases the instability of sensor network comparing with LEACH-FL, LEACH and SEP taking into account energy level and distance to the base station.

In this paper, **Bahmani-Firouzi et al. (2014) [4]**, 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.

Alihodzic, et al. (2014) [5] 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.

Zhao, Miao et al. (2014) [6] 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.

Rawat, Priyanka et al. (2014) [7] a brief review on the recent approaches on wireless sensor network has been proposed in this work. This study helps to resolve the numerous problems on WSN. In this paper, both proactive and reactive routing techniques are used for routing of data in sensor network. Furthermore, several schemes which are recently used for solving the congestion problem has also been studied in thispaper.

Krishnan, A. Muthu, and P. Ganesh Kumar (2015) [8]An Effective Clustering Approach with Data Aggregation Using Heterogeneous WSN has been presented in this paper. In the proposed algorithm, data gathering based on the clustering architecture with TDMA time slot helps to achieve an efficient data gathering approach. Further the data aggregation on the nodes within the cluster reduces the data traffic. The efficiency of the proposed model is evaluated based on number of data packets received, network lifetime and residual energy. The proposed algorithm achieves network lifetime increase with low energy utilization compared to other algorithm. The aim is not to highlight our self but give a solution for network researchers and motivate to work in a new direction.

Jose, Deepa V., and G. Sadashivappa et al. (2015) [9] proposed a novel scheme for energy enhancement in wireless sensor networks. In this paper a prologue to the two popular bioinspired optimization techniques ABC and PSO are given. The newly proposed strategy with sink mobility is compared with the ABC algorithm and the simulation results prove the efficacy of the proposed one in terms of average packet delay and the life time. It is necessary for a WSN to have less delay in packet delivery and the average energy should be high. These criteria are satisfied in the proposed algorithm. So this approach will be suited for real time applications where time delay plays a major role.

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.

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

$where\ w_1, w_2\ and\ w_3\ are\ weights\ which\ satisfy\ the\ equation$
$w_1 + w_2 + w_3 = 1$
$and\ P_L\ is\ the\ packets\ lost\ ,$
$R_E\ is\ the\ residual\ energy\ and\ d_{ij}\ is\ the\ distance\ between\ nodes$

Based on the value of this objective function a decision of placing the relay node is considered. If the value of the objective function for the route is less than threshold (30 % of the maximum value) then the relay node is placed in the route.

RESULTS AND DISCUSSIONS

The performance parameters for the comparison of basic and proposed approach are

Average End to End Delay: it is given by:

$$Delay = (Packet\ received\ by\ receiver\ time - generated\ time)$$

Figure 2 shows the Average End to End delay comparison between the basic and proposed approach. The delay in the proposed approach reduces because of the reduction in number of retransmissions.

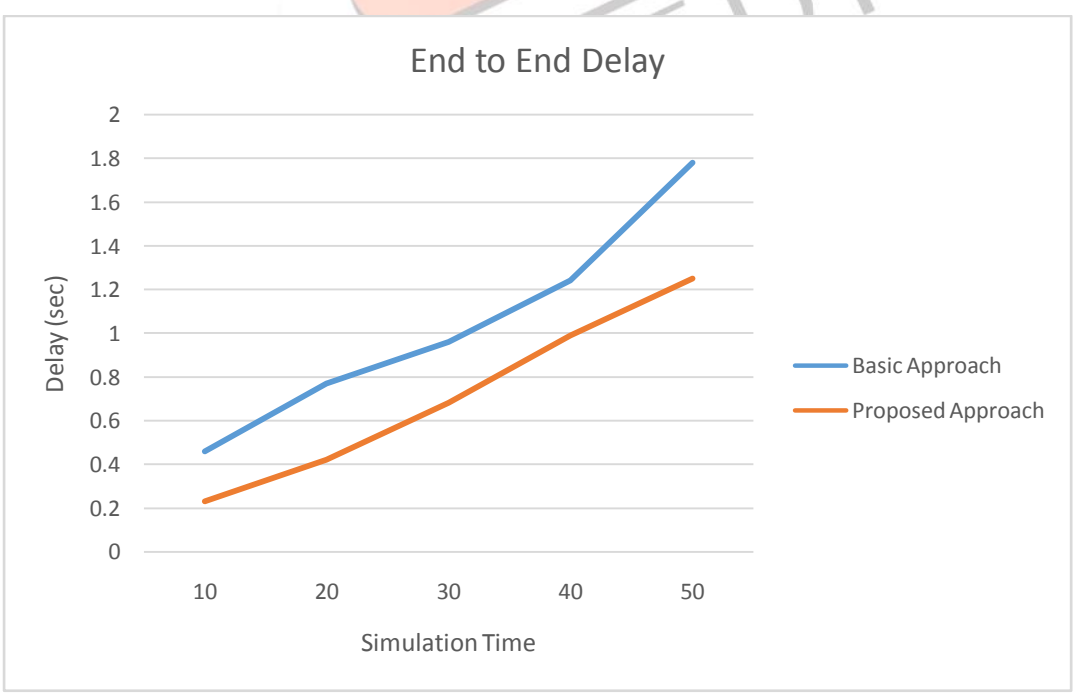

Fig 2 End to End Delay

Residual Energy: Residual energy is the energy remaining at the node after the communication cycle. Figure 3 shows that the energy remaining at the node in the proposed approach is more than the basic approach. This is due to the fact that the number of packets retransmissions in the network decreases.

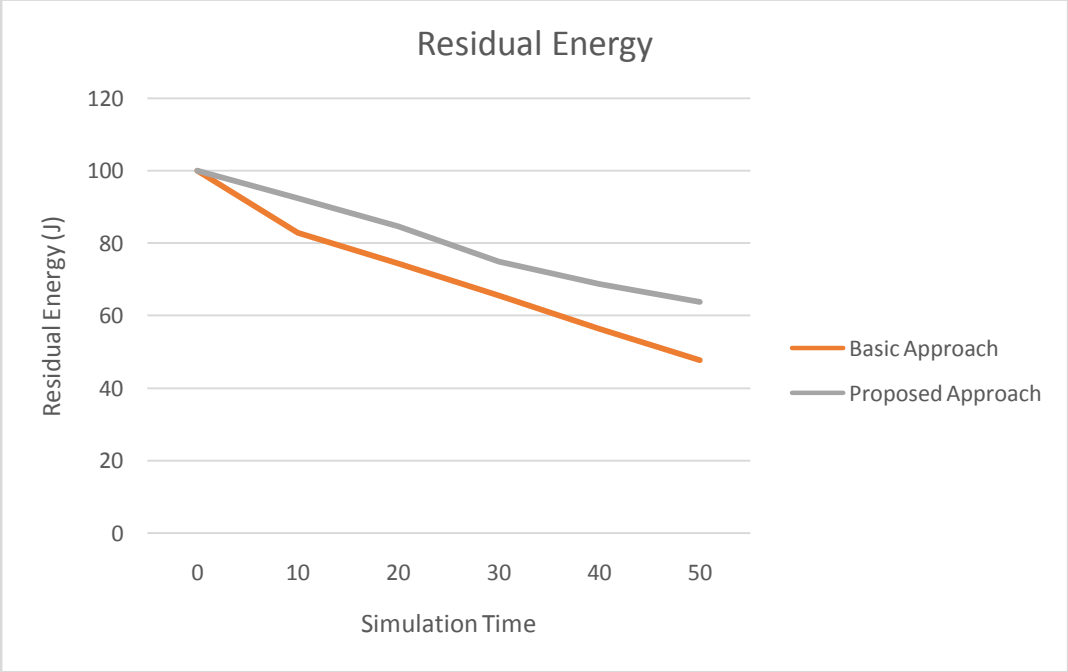

Fig 3 Residual Energy

Number of Hops: It is evident from the graph that number of hops in the network increases as the simulation time increases. This is due to the fact that more and more nodes are trying to transmit the data and more number of new paths are calculated.

Fig 4 shows the comparison of number of hops for the basic and the proposed approach. The relay nodes are placed near the nodes whose energy is more consumed as compared to other nodes in the network. Graph shows the proposed approach uses less number of hops as compared to the basic approach and requires less number of relay nodes.

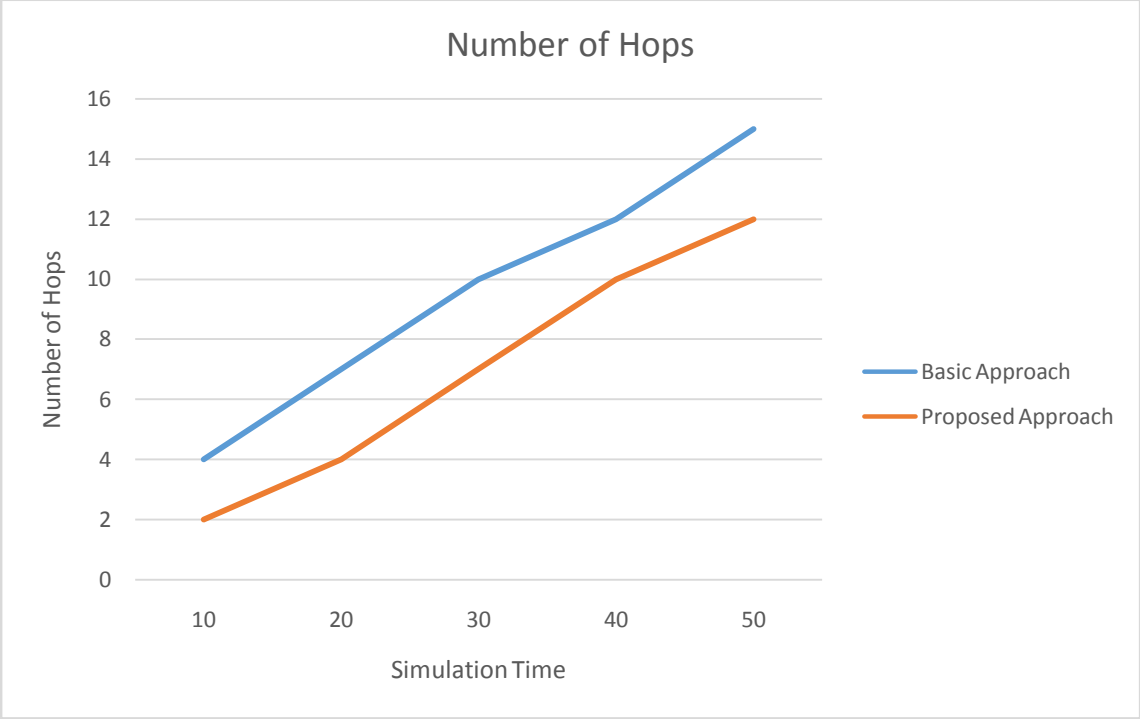

Fig 4 Number of Hops

CONCLUSION

Relay or ferry node placement in the wireless sensor networks is an important issue of concern in recent years. Many approaches are proposed by the researchers in recent times which uses the relay nodes an important addition in the network from the point of view of energy consumption. In the present work for placing the relay node in the network firstly the location for the placement is defined. The location for the placement of relay node is near the dead node which previously involved in communication cycle. For the location calculation an objective function is designed which is based on the values of the number of packets lost, residual energy of nodes in the network and distance between the nodes. 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 number of hops required in the network from source to destination.

In the future various other machine learning and meta heuristic algorithms must be implemented on the objective function to further improve the accuracy of the results. Several other statistical approaches must also be used like Bayesian Filters, Kalman Filters and Extended Kalman Filters to improve the non linearity of the problem so as to improve the acceptance of results.

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