An Efficient Cluster Head Election Algorithm for Adaptative Network

Shivani Agrawal, D. Srinivasa Rao

Abstract*— A wireless sensor network is a distributed real-time network configuration. The designing of a wireless sensor network should be formulated with keeping following terms in consideration such as the systems is completely ad-hoc and works with wireless channel, have limited power and with dynamically changing sets of resources. Due to this the network performance is depends on their power consumption and efficient resource consumption. In such kind of network the mobility added advantages but the mobility sometimes causes the performance losses thus network clustering techniques are helps to improve the resource utilization. Thus the proposed work indented to investigate the clustering techniques for wireless sensor network. The proposed work is an en efficient cluster head election algorithm for adaptive network. That techniques have two major disadvantages first there are no limits of connections for cluster head thus high load on cluster heads and Second during the load frequently loss of energy. In order to resolve such issue in network a new technique of cluster head selection is suggested in this proposed work. The proposed technique invigilates the nodes energy and also implements the load balancing of cluster head for improving the performance of network.

Index Terms*—Wireless sensor network, clustering, cluster head election.

I. INTRODUCTION

Wireless sensor networks are the new generation network and information distribution technology. Various innovative approaches are used for improving this technology for their performance and security issues. Among these approaches the clustering is one of the most essential contributions. In this presented work a traditional approach of clustering is studied and an improvement is proposed and implemented. This chapter provides an overview of the proposed concept over the cluster formation in wireless sensor network. Now in this world becomes small, due to advancement of communication technology. Quickly growing networks and modern techniques making revolution in this domain, according to the structure of network is categorized in two main domains first connection oriented and wireless oriented. While, according to their utility and applications the wireless communication is also illustrates in two parts, first short range or indoor communication and second broad range or outdoor communication. A wireless sensor network is a distributed real-time system. Unfortunately yet very little work is applied in these new system and always a new solutions are often essential in all areas of the system [1].

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Shivani Agrawal, Department of Information and technology, Medicaps Institute of Technology and Management, Indore, Madhya Pradesh, India.

Prof. D. Srinivasa Rao, Department of Information and Technology, Medicaps Institute of Technology and Management, Indore, Madhya Pradesh, India.

The main cause is that the set of assumptions underlying earlier work has changed dramatically. Most of the earlier distributed systems research works on the following assumption like the systems are wired; powers is unlimited, not works on real-time, with a fixed set of resources, have user interfaces such as screens and mice, treat each node of the system as very significant and are location independent. In contrast, the designing of a wireless sensor network should be formulated with keeping following terms in consideration such as the systems is completely ad-hoc and works with wireless channel, have scarce power, are real-time, utilize the sensors and actuators as interfaces, with dynamically changing sets of resources, aggregate behaviour is also important there and location is very critical. Various wireless sensor networks also exploit negligible capability devices which places a further strain on the ability to use precedent solutions. In this presented work the wireless sensor network is investigated and their performance enhancement techniques are studied among them the clustering approaches are improves the network scalability and performance thus in this proposed work a clustering approach namely highest degree algorithm of network clustering is studied and an improvement on traditional clustering approach is proposed. The detailed modification on the previous algorithm is discussed in further sections.

A. Domain Overview

Wireless sensor network is a collection of network devices known as nodes; these nodes are mobile in a specific area of network. The nodes are designed with the Wi-Fi enabled devices which able to send, receive and forward data. These Wi-Fi devices having a specific radio range for communication, therefore these devices are communicate only when a node available in their radio range. Additionally for communicating with those devices which are not in their radio range the nodes are following the relaying concept. During information relay the data is transmitted using cooperative manner via the intermediate routers in network. This property of such network make more valuable for different network applications. On the other hand the mobility in wireless network can harm the network performance in terms of available bandwidth, packet delivery ratio and end to end delay. This issues are arises when an intermediate node leave their own place, then the existing path between two communicating nodes are interrupted and the losses may arises. In order to improve the performance of the network clustering approaches are utilized that improves the connectivity and the network services. The proposed work is a technique for improving the network performance by improving the traditional clustering technique for data and information distribution.

Therefore the traditional highest degree algorithm is optimized to enhance the performance of network and their scalability. The proposed technique includes the load balancing concept and energy optimization technique for improving the cluster performance.

II. PROPOSED WORK

The proposed work is based on the traditional highest degree algorithm. Basically the traditional highest algorithm first estimates the numbers of nodes are directly connected with a node are selected as the cluster head. But the key issue of this cluster head selection algorithm is that when the numbers of nodes are connected through the cluster head then the load on the cluster head is increases much effectively. Due to this the loss in transmission is observed in addition of that the due to high load on network nodes affect the network performance in terms of energy. Therefore that is required to enhance the traditional clustering approach by introducing some quality of parameters. Based on this concept to distribute the load on the network cluster heads first the cluster head selection process is restricted using the energy constrains thus first each node in network is evaluated and their number of active connections are estimated. Now each estimated number of connections is compared with their neighbour connection list. During this process a primary list is prepared which are more fit according to the highest degree algorithm that selected nodes are considered as the pre-cluster heads. Now the energy of each node is observed if the energy of node is less than 50% than these nodes are not much efficient these nodes can be removed from the pre-cluster head list. Now the remaining nodes are efficient and able to wear load for the cluster head. After selecting the cluster heads the network needs a load balancing mechanism for improving the clustering experience of the wireless sensor network. Thus using the numbers of connected nodes a connection threshold is estimated. This threshold value is used to prepare a check over the number of connections if the number of connections are increased as compared the defined threshold then the cluster is sub-divided in two groups or two different clusters.

III. PROPOSED ALGORITHM

This section describes the proposed enhanced algorithm for the cluster head selection using the highest degree algorithm. The summarized steps of the algorithm are discussed as:

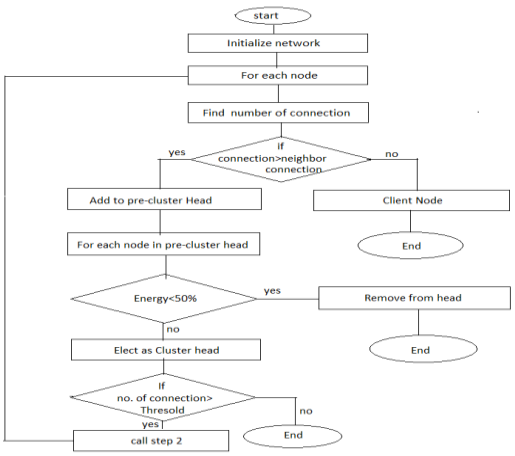

Figure 1. Proposed cluster head selection

Suppose there are N nodes in the network thus the following process is used to create the cluster of sensor nodes.

1. for each node in network do
    a. C= find the active connections
2. End for
3. If the C_i has higher connections among neighbours
    a. elect as pre-cluster head
4. for each node in pre-cluster head
    a. if $nodeenergy \leq 50\%$
        i. remove from the pre-cluster heads
    b. end if
5. end for
6. Remaining nodes are selected as cluster heads

Load balancing

The load balancing of the cluster head needs a distribution threshold that threshold value is computed as:

$$threshold = \sum_{i=1}^{N} \frac{clusterheadconnections}{totalclusters}$$

Now follow the following process

1. if cluster head connections > threshold
    a. call step 2 of base algorithm
2. end if

IV. IMPLEMENTATION

This section describes the basic implementation details and network configuration that help to simulate the desired network protocol.

A. *Simulation Setup*

In this section provides the desired network configuration for simulation of proposed location estimation and simulation.

Table 1 Simulation Setup

Simulation properties	Values
Antenna model	Omni Antenna
Dimension	750 X 550
Radio-propagation	Two Ray Ground
Channel Type	Wireless Channel
No of Mobile Nodes	15
Routing protocol	AODV
Time of simulation	10.0 Sec.

B. *Simulation Scenarios*

This section describes the simulation scenarios of the implemented protocols and their description. In order to simulate the improvement on the traditional cluster head selection technique there are two different simulation scenarios are presented.

V. RESULTS ANALYSIS

This chapter provides the results discussion about the developed wireless sensor networks routing performance and their analysis thus according to the proposed simulation scenarios,

two similar networks are configured with different routing techniques first implemented with the traditional protocol [2] and second is implemented with the proposed routing protocol.

A. *End to end delay*

End to end delay provide the information about the additional time consumed during the transmission of data. In order to simulate effectiveness of the presented routing protocol that is compared with traditional routing protocol performance.

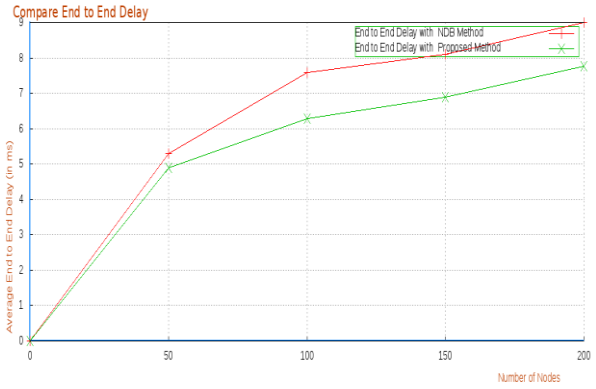

Figure 2. End to End Delay

The comparative end to end delay of the networks are given using figure 2 in this diagram the red line simulates the performance of the traditional network and the green line shows the end to end delay of the proposed network protocol. to represent the performance X axis of the diagram contains the number of nodes in network and the Y axis contains the end to end delay of the network.

B. *Packet delivery*

The total number of packets sent by source device and successfully received packets ratio is responsible for PDR packet delivery ratio. That may include RREP and RREQ packets too. The packet delivery ratio is estimated using the below given formula.

$$Packetdeliveryratio = \frac{totalrecivedpackets}{Totaltransmittedpackets} X100$$

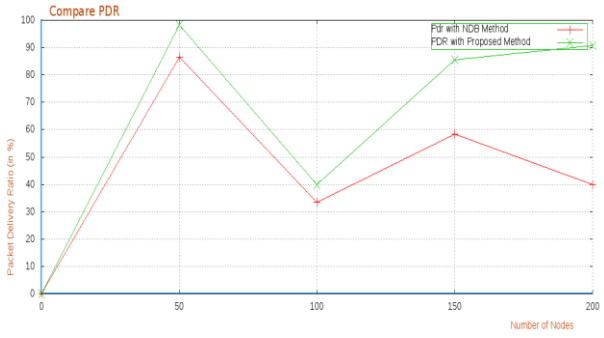

Figure 3. Comparative Packet Delivery Ratio

The comparative packet delivery ratio of both the routing protocols are given using figure 3 in this diagram the X axis includes the numeral of knots in experimental network and the Y axis shows the percentage packet delivery ratio of the system. According to the acquired outcomes the proposed technique (given using green line) delivers more data packets as compared to the traditional (given using red line) cluster head selection algorithm.

C. *Throughput*

Network throughput is the average rate of successful message delivery over a communication channel. This data may be delivered over a physical or logical link, or pass through a certain network node. The throughput is usually measured in bits per second (bit/s or bps), and sometimes in data packets per second or data packets per time slot.

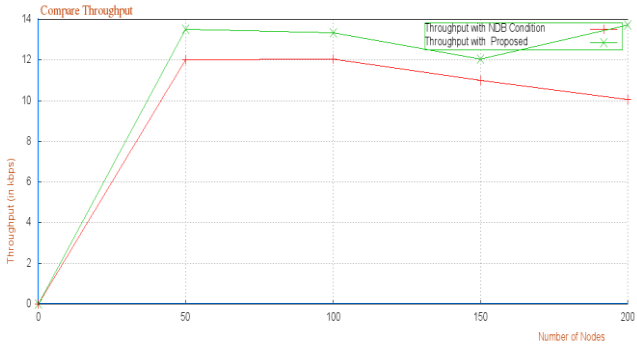

Figure 4. Comparative Throughput

According to the given figure 4 the performance of both the routing protocols are compared in terms of throughput. The given diagram contains the performance of the traditional cluster head selection algorithm using red line and the performance of the proposed technique is given using green line. In this diagram the X axis illustrates the numeral of knots in network and the Y axis illustrates the through-put of network in terms of KBPS. According to the obtained throughput the performance of the proposed technique is much adoptable as compared to the traditional technique.

D. *Energy Consumption*

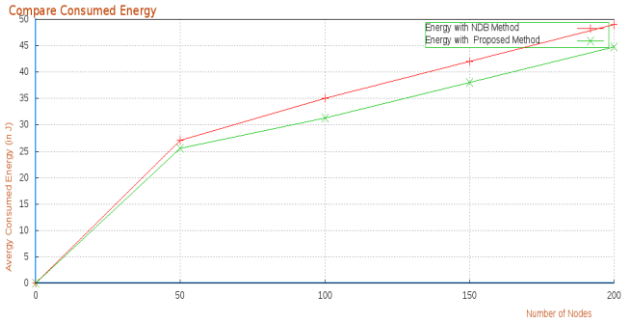

Figure 5. Comparative Energy Consumption

E. *Routing Overhead*

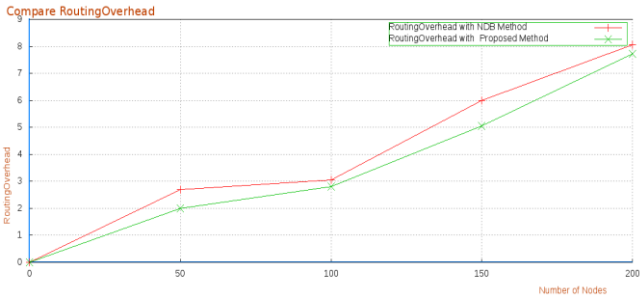

Figure 6. Comparative Routing Overhead

VI. CONCLUSION AND FUTURE WORK

The proposed work is an investigation of the wireless sensor network and their cluster organization technique. Thus the conclusion is made on the basis of the basis of the experimentation and observations and the limitations are organized using the future extension of the work.

VII. CONCLUSION

The wireless sensor network is one of most popular network technology now in these days, because the network nodes are able to communicate and aggregate the information from one point of network to another point of network. That technology is used for monitoring, invigilation and various other scientific and engineering applications. The network is organized through nodes and the connectivity among these nodes is enabled through the wireless technology. To communicate each other these nodes are relay the information through their neighbour nodes thus first node deliver the information to next node and next node serve it to next node. Mobility in such network nodes added advantages on the other hand the mobility can degrade the performance of network due to path break or the network partitioning. Thus the clustering in network is utilized for enhancing the connectivity and availability of network services. The proposed work is an enhancement on the traditionally available clustering technology which is frequently known as the highest degree algorithm. In this technique the key issue is load balancing of the cluster head and frequent loss of energy thus the new concept to load normalization and cluster head election is proposed that normalize the load on cluster head using their buffer length and the energy consumption. The optimized cluster head selection technique is simulated using the network simulator 2 environments and comparative performance is evaluated with the similar cluster head selection algorithm as given in [2]. The proposed technique enhances the performance of network in terms of end to end delay, throughput and packet delivery ratio as compared to the traditionally available technique of the cluster head selection algorithm. The comparative performance summary is given using table 2.

Table 2 performance summary

S. No.	Parameters	Traditional technique	Proposed technique
1	Packet delivery ratio	Low	High
2	End to end delay	High	Low
3	Throughput	Low	High
4	Energy Consumption	High	Low
5	Routing Overhead	High	Low

According to the evaluated results the performance of the proposed cluster head selection technique is found efficient as compared to the traditional cluster head selection algorithm, thus the proposed technique more adoptable as compared to the proposed technique.

FUTURE EXTENSION

The proposed work is adoptable due to the high throughput consumption of network, low end to end delay during data transmission and high packet delivery ratio as compared to the traditional technique. In near future that technique is more optimized to enhance more performance parameters for network.

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