

Enhanced Cluster Based Distributed Fault Tolerance Algorithm for Mobile Node in WSN

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ABSTRACT

In recent years, wireless sensor networks (WSNs) have gained increasing attention from researchers and scholars. One of the major issues in wireless sensor network is developing an energy-efficient and fault tolerance clustering protocol. Hierarchical clustering algorithms are very important in increasing the network's life time. Thus, improving the energy and find fault in the networks becomes important.

In this research work, we purposed a new algorithm named as ECBDFT algorithm for clustering and for selection of cluster head selection to improve energy efficiency and fault tolerance. In addition, comparison of DFCA with purposed system also evaluated in research work. This modified approach proposes selection of a cluster head selection with good performance and reduced overhead and computational complexity. Our purposed algorithm ECBDFT, improve performance with faster convergence.

Key words: Network clustering, Fault-tolerance, sensor nodes

1. INTRODUCTION

A sensor network is a deployment of massive numbers of small, inexpensive, self powered devices that can sense, compute, and communicate with other devices for the purpose of gathering local information to make global decisions about a physical environment" [4].The size of each sensor node varies with applications and its cost depends on its parameters like memory size, processing speed and battery [4].Today, wireless sensor networks are widely used in the commercial and industrial areas such as for e.g. environmental monitoring, habitat monitoring, healthcare, process monitoring and surveillance.

1.1 CLUSTERING & ITS TECHNIQUES: Connecting two or more computers together in such a way that they behave likes a single computer. Clustering is used for parallel processing, load balancing and fault tolerance.

Clustering in WSNs involves grouping nodes into clusters and

selecting a cluster head (CH) such that:

- The members of a cluster can communicate with their CH directly.
- A CH can forward the aggregated data to the central base station through other CHs.

1.2 FAULT TOLERANCE: Fault tolerance techniques attempt to prevent lower level errors (caused by faults)

from propagating into system failures. By using various types of structural and informational redundancy, such techniques either mask a fault or detect a fault and then affect a recovery process which, if successful, prevents a system failure. Fault tolerance techniques are LEACH, EECH, HEED, DFCA and etc.

1.3 DISTRIBUTED FAULT TOLERANCE & CLUSTERING ALGORITHM (DFCA): The clustering technique is used where network organizes around a small set of cluster heads which then gather data from their local cluster aggregate this data and transmit it to the base station. Since, sensor nodes are often deployed in harsh environments, they are prone to failure. Cluster-head failure can leave a cluster disconnected from the base station until the network reorganizes again.

1.3.1 CLUSTERING ALGORITHM [3]

Step 1: ComRangeCH(Si) = {};

BackupSet (Si) = {};

Step2: while(Si receiving HELLO message from Gk)

2.1: Si becomes the elements of

COset i k i

ComRangeCH S G

ComRangeCH S = () U

2.2: () endwhile

Step3: if (timeout && no HELLO message received)

Then

S_i becomes a member of $UnCOset$.
 End if
 Step 4: if($S_i \in UnCOset$) then
 4.1: S_i broadcasts a HELP message for backup.
 4.2: while (S_i receiving reply from S_j)
 $BackupSet(S_i) = BackupSet(S_i) \cup S_j$
 endwhile
 4.3: if ($BackupSet(S_i) \neq \emptyset$)
 Then
 S_i uses S_j from $BackupSet(S_i)$ as a relay with highest residual energy to send the data to the CH.
 Endif
 Else
 4.4: S_i calculates cost of all these CHs according to equation 4.4 and joins the CH with the highest cost value.
 4.5: if (S_i receives any HELP message) thenSend reply message.
 End if
 End if
 Step 5: Stop.

1.3.2 OVERVIEW OF ASSOCIATION RULES

1. A set of sensor nodes denoted by $S = \{S_1, S_2, S_n\}$
2. A set of CH denoted by $G = \{G_1, G_2, \dots, G_m\}$
3. $Dist(S_i, S_j)$ denotes the distance between two nodes S_i and S_j .
4. $E_{residual}(S_i)$ denotes the remaining energy of S_i .
5. $ComRangeCH(S_i)$ is the set of all those CH, Which are within the communication range (RS) of node S_i . Therefore,
 $ComRangeCH(S_i) = \{G_j | Dist(S_i, G_j) \leq RS \wedge G_j \in G\}$
6. $Neighbor(S_i)$ is the set of all those sensor nodes, which are within the communication range of node S_i .

1.3.3 FAULT TOLERANCE ALGORITHM [3]

Step 1: S_i broadcast a HELP message within its communication range.
 1.1: $ComRangeCH(S_i) = \{\}$;
 1.2: $BackupSet(S_i) = \{\}$;
 Step 2: while (S_i receiving reply)
 If (reply is from gateway G_k)
 2.1: S_i becomes the elements of $COset$ iki
 $ComRangeCH(S_i) = G_k$
 $ComRangeCH(S_i) = () \cup G_k$
 2.2: ()
 Else if (reply is from sensor node S_j)
 $BackupSet(S_i) = BackupSet(S_i) \cup S_j$
 endif
 endif
 endwhile
 Step 3: if($S_i \in UnCOset$ & $BackupSet(S_i) \neq \emptyset$) then
 S_i uses S_j from $BackupSet(S_i)$ as a relay with highest residual energy to send the data to the CH.

Else

S_i calculates cost of all CHs from $ComRangeCH(S_i)$ according to equation 4.4 and joins the CH with the highest cost value.

End if

Step 4: Stop

2. LITERATURE REVIEW

A lot of research has been done in the field of association rule mining and apriori algorithm.

Md. Azhrauddin et al. (2013) In this paper, presented a distributed fault-tolerant clustering algorithm for WSNs called DFCA. In the cluster formation phase, the algorithm uses a cost function of the CHs to form proper cluster with the care of the uncovered sensor nodes. DFCA has presented an efficient mechanism to recover the faulty cluster members in a distributed way [3].

Ademola P, et al. (2011) in this paper, A Novel Clustering Algorithm for Energy Efficiency in Wireless Sensor Networks (ANCAEE) has been proposed. The algorithm achieves good performance in terms of minimizing energy consumption during data transmission and energy consumptions are distributed uniformly among all nodes. ANCAEE uses a new method of clusters formation and election of cluster heads. The algorithm ensures that a node transmits its data to the cluster head with a single hop transmission and cluster heads forward their data to the base station with multi-hop transmissions. Simulation results show that our approach consumes less energy and effectively extends network utilization [1].

Sunkara Vinodh Kumar, A. et al. (2013) there have been profound studies on Wireless Sensor Networks during the recent years. As the sensors in the network have limited battery power, enhancing the lifetime of a network is the basic aim of designing an energy efficient routing protocol. Clustering protocols aim to achieve energy efficiency. The whole network is divided into clusters with a cluster head node for each cluster. The data from sensors inside a cluster is aggregated at cluster head. This eliminates a lot the redundancy in packet forwarding. Low Energy Adaptive Clustering Hierarchy (LEACH) is considered to be benchmark protocol in Clustering/Hierarchical based protocols. Multihop-LEACH, LEACH-MF, MR-LEACH, and Secure LEACH, or M-LEACH are examples of few Clustering Protocols derived from LEACH [6].

Garauv Gupta et al(2003) In this paper, presented a efficient way to enhance the lifetime of the system is to partition the network into distinct clusters with a high-energy node called gateway as cluster-head. Failures are inevitable in sensor networks due to the inhospitable environment and unattended deployment. However,

failures in higher level of hierarchy e.g. cluster-head cause more damage to the system because they also limit accessibility to the nodes that are under their supervision. In this paper we propose an efficient mechanism to recover sensors from a failed cluster [2].

3. OBJECTIVE

Objectives are as follows.

1. Selection of Cluster Head (CH) by initiator to reduce broadcasting.
2. Using the concept of primary and secondary CH.
3. In case of fault, choosing next CH (secondary CH) from its members by base station rather than members joining other CH.
4. Detecting the faulty node by the selected CH.
5. Comparing performance of DFCA with proposed method

4. RESEARCH METHODOLOGY

4.1 NETWORK SIMULATOR

Simulation can be defined as “Imitating or estimating how events might occur in a the aid of technology, or combinations. The value lies in the pacing you under realistic conditions that change as a result of behaviour of others involved, so you cannot anticipate the sequence of events or the final outcome.

4.1.1 NS2 OVERVIEW

NS [5] is an event driven network simulator developed at University of California at Berkeley, USA, as a REAL network simulator projects in 1989. NS is a discrete event network simulator where the timing of events is maintained by scheduler and able to simulate various types of network such as LAN and WPAN according to the programming scripts written by the user. Besides that, it also implements variety of applications, protocols such as TCP and UDP, network elements such as signal strength, traffic models such as FTP and CBR, router queue management mechanisms such as Drop Tail and many more. There are two languages used in NS2 C++ and OTcl (an object oriented extension of Tcl).

4.2 PROPOSED ALGORITHM

- Step1. Deploy the nodes
- Step 2. Arrange the whole network into clusters
- Step 3. Choose the base station from network.
- Step 4. Choose initiator from every cluster.
- Step 5. Choose cluster head (CH) and secondary CH with highest energy level for each cluster by the initiator.
- Step 6. Each cluster member will ping to its respective cluster head.
- Step 7. If any cluster head find that if its member did not send ping message to it, then it will wait for few seconds.

Step 8. If after few seconds, cluster head still not receives any message then it will put the member into the suspected list of the nodes

Step 9. After cluster head checks all its members then process of data aggregation will start where nodes will send the sensed the data to their cluster heads

Step 10. All the cluster heads will send acknowledgement of the received data to the base station,

Step 11. If any base station finds that it is not receiving the ack from cluster head then base station will put it in suspected list and start the process of new cluster head(secondary CH) selection.

Step 12. Base station will choose one member (secondary CH) from that respective cluster, and that member (secondary CH) must send ack to the base station. If base station receives the message then it will new cluster head.

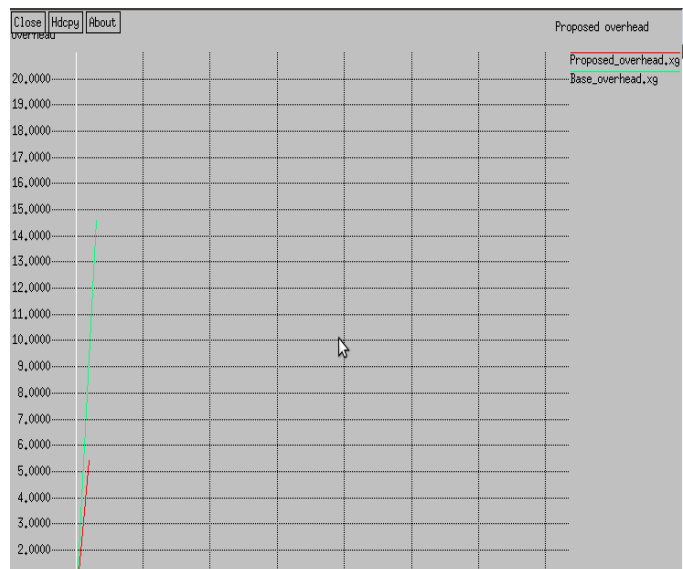
5. RESULTS

The comparison between DFCA and Proposed Algorithm is performed over the common factors like overhead, set-up time and no. of alive node in the network over different simulation time. Also find the faulty node and CH during the communication.

1.1. OVERHEAD

1.2. OVERHEAD = Routing packet sent / Data packet received

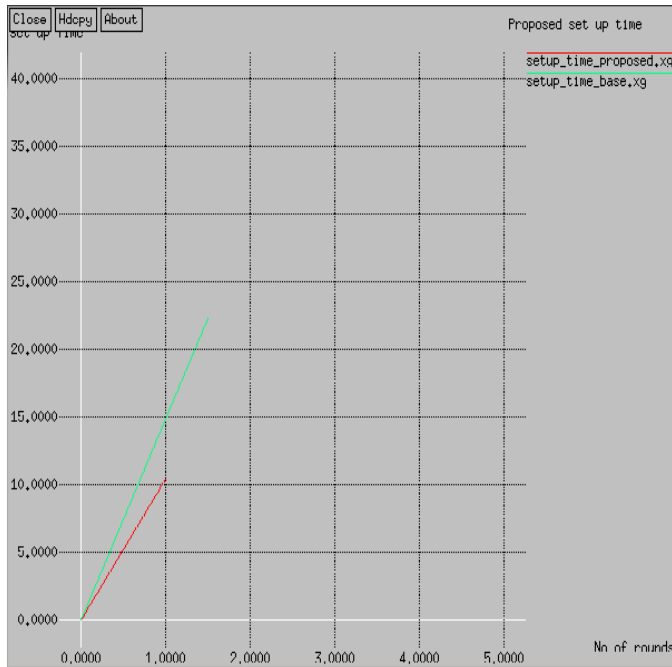
Algorithm Name	DFCA	PROPOSED
No. of Nodes	50	50
Overhead	14	5



SHOW THE OVERHEAD

5.1 SET UP TIME

Algorithm Name	DFCA	PROPOSED
No. of Nodes	50	50
Set Up Time (sec.)	22	10

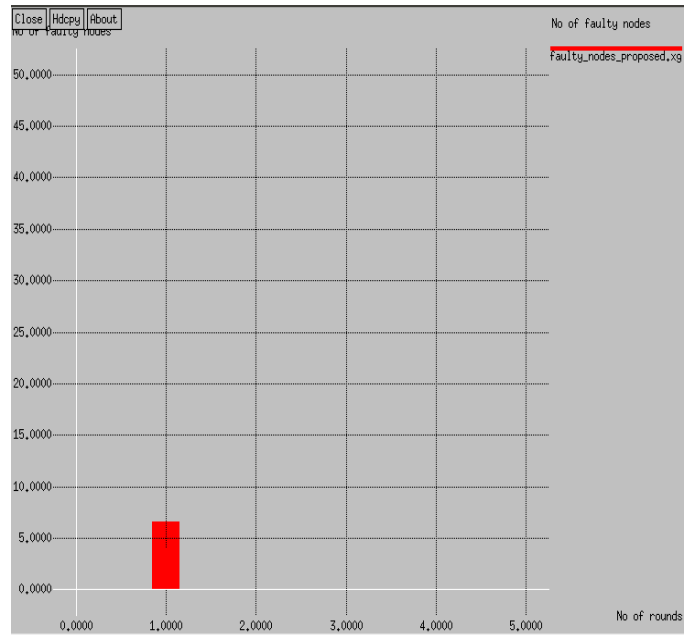


NETWORK SET UP TIME

5.2 FAULTY NODES

Find Two types fault in Proposed : 1) Energy drainage 2) Hardware fault
 DFCA = None

Algorithm Name	DFCA	PROPOSED
No. of Nodes	50	50
Find Fault	Nothing	Two types fault
Faulty Node	None	4



SHOW THE FAULTY NODES

5.3 ALIVE NODES

Algorithm Name	DFCA	PROPOSED
No. of Nodes(1 st level)	50	50
No. of Alive Node(2 nd level)	21	46



SHOW THE ALIVE NODES

2. ACKNOWLEDGMENT

I am really grateful to my guide and my friends for this paper. It would not be possible to complete my paper without their help and valuable support. Last but not the least, I thank to my parents and family members.

3. CONCLUSION & FUTURE WORK

We compared the proposed algorithm with existing algorithm which was DFCA. The simulation results showed a higher system lifetime for the proposed algorithm compared other algorithm. Based on our practical results it is conclude that proposed algorithm is perform better in WSN and give better output and performance .In the future, the proposed algorithm can be enhanced to produce the results quicker than the existing work and with less energy consumption. In the future, the authors/researchers can improve or develop a new model use other parameter to enhance the performance better than the proposed model.

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