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Identifying Faulty Nodes in Wireless Sensor Network to Enhance Reliability

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Abstract-WSN having several major issues to deliver information from source to sink. Such that secure data transmission, energy consumption, balancing the load and fault tolerance will be the major tasks. In the WSN, one node communicates with its neighbour nodes with limited energy source. So if any node does not work properly or become faulty nodes, which have less initial energy level, bandwidth to communicate with faulty nodes. Hence there is a need of system which can overcome with fault and give the reliable communication. Fault may also occur due to the dislocation of sensor nodes, battery depletion or instability of transmission medium.This proposed work will identify the faulty nodes and calculate the end to end delay as well as residual energy. Hence a reliable communication for all nodes in the WSN can be attained.

Keywords: WSN, Faulty node, AODV, End-to-end delay, Reliability.

I. INTRODUCTION

Wireless sensor networks is used for many applications such as target tracking, military, environmental monitoring and so on.WSN is a collection of sensor nodes which resources consumesless power (energy), high transmission rate and less data storage.The main objective of the WSNis to sense the physical conditions and direct the readings to the base station (sink) through the neighbour nodes in the network. There are two kinds of WSN: Structured and Unstructured WSN. In this Structured Network, nodes can be deployed physically. But problem occurs during the deployment at a sensor in Unstructured WSN.it is the case, where human cannot reach and nodes are deployed randomly which supports redundancy. Redundancy characteristics of WSN can also help to achieve reliability in the time of node failures.Sensor nodes having the limited power supply as these nodes are working on battery. If any nodes become failure, then neighbour nodes of failure nodes will simply waste the energy during communication. Therefore there is a necessity of efficientfault tolerant mechanism to enhance the communication and QOSof the network. In thisnovelapproach, the network is designed with four anchor nodes which will be in a fixed location.Hence this anchor nodes will monitor the activities of all other sensor nodes in the network. The initial energy of all the sensor nodes in the network will be static. After each transmission of packets the energy of node will be reduced. Some nodes will utilize more energy due to which there is a chance of node failure. Hence the communication will not be possible in the network. So the faulty node should be detected is a major task to make the system fault tolerant. Hence the anchor nodes will help tofind the location of the faulty node in the network created. This approach will calculate the time taken for the transmission from source to target and also residual energy in WSN. Thus we can avoid the fault and get an effective network and the node communication being reliable.

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II. LITERATURE SURVEY

Jiao Zhou et al. [1] [2017] proposed a virtual backbone for WSN by connected dominating set (CDS). That makes a fault lenient virtual backbone with coverage and connectivity for high redundancy. The existing method show performance ratio of 62.3 in the unit disk graph by the approximation algorithm for minimum (2, m) CDS problem. The suggested method reduces it to 27 on minimum (3, m) CDS problem. The performance ratio is calculated by k-connected m-fold dominating set, where $ is the max value in "unit disk graph", in their paper. The major benefits of the inventing method is an improvement in performance ratio than existing method. So the communication is more reliable than the previous method. The Future work is to design a distributed algorithms for a fault tolerant system with high reliability. Gholamreza kakamanshadi et al. [2] [2015] proposed anexploration of fault tolerant mechanisms on wireless sensor networks. The failure may cameby some reasons such as energy drop, dislocation of sensor nodes, instability of transmission link and environmental depletion and so on. Fault tolerance can be gained by reliable communication of data, accuracy in delivering, and energy efficient communication. These characteristics are the main issues of failure of network. This work analysis the fault tolerant mechanisms which is based on Redundancy, Clustering and Deployment mechanisms and to evaluate the advantages and limitations of these techniques, in their work.

The deployment based method is the most relevant method. It can be energy efficient, effective utilisation of lifetime and the reliability in communication among nodes. Chafiq Titouna et al. [3] [2016] suggest a scheme of detecting fault in WSN, by finding the faulty nodes in a clustered network. There are two levels in this process, initial stepis taking place inside the nodes and the following level is in the cluster head or gateway. An authentication is done on each levels, so we should get a table of packet delivery rate of all nodes. Then we easily find the failure ones from the delivery rate table. The processes are evaluated through some qualities such as accuracy of detecting values, false alarm ratio, control overhead and memory overhead, in their paper. The major lead of proposed method was the performance rate is improved than the existing FDWSN system. So that it's a new system which can be detect fault efficiently than propose one. Ketaki Vaidya et al. [4] [2010]planned a pre-failure activity to recover the nodes from the failure state and to restore the connectivity and coverage of WSN become stable. By selecting a spare node from the network within the range of failure node and assign it. The spare node can be assigned through similar coverage overlap and node degree of failure node. These node can adjusted by cascaded motion to the failure end, in their paper. The major advantage of these proposed method gives a backup to every nodes in that network from failure.This helps the immediate restoration of spare node being possible and keeps the communication reliable. Jinran chen et. al. [5] [2006] proposed an algorithm for localized fault detection to identifythe faulty sensor nodes in a network. In this work the performance can be assessed by two processes that are "faulty sensor detection accuracy" (FSDA) and "false alarm rate" (FAR). FSDA is for calculating the rate of fault node detected and FAR is for the rate of non-faulty nodes, this helps the communication be stable by avoiding that fault node in their paper. The major benefitsof the suggested algorithm shows high detection accuracy as well as low false rate on over the existing fault detection algorithms. Zhiwei gao et al. [6] [2015] proposed ananalysis of fault detection and control methods on WSN. The objective of fault diagnose is to spotirregularities in the networks and fault detection is protect the components form the damages. These mechanisms are implemented for improving system reliable.The methods such as model based, signal based, data driven and hybrid methods are used for detect the fault. Fault tolerant methods are passive and active fault tolerant control, in their paper. The main advantage on this proposed work is to analyse the efficient fault tolerant methods to achieve reliable communication. Yali zeng et al. [7] [2016] present two algorithms to achieve restoration of faulty WSN. These are "Full 2 Connectivity Restoration Algorithm" (F2CRA) for reliable communication from node to node and "Partial 3 Connectivity Restoration Algorithm" (P3CRA) is to balance the load for fault tolerant reliable communication. F2CRA is suitable for cost relevant models and P3CRA focuses on quality of network, in their paper. The major advantage among the existing system is efficient fault tolerant functionwith higher reliability and balancing load among the network properly. Exact restoration of connections gave additional strength to the network and enhance the lifetime of network. Koffka Khan et al. [8] [2015]implemented an improved AOMDV protocol which can be react to lossy environments and effective to fault tolerance. A packet loss percentage metric is added to node disjoint paths for calculate the amount of packet loss in that communication. In this algorithm, which calculates theamount of packet loss by the implementation of traffic sink nodes, in their paper. The major advantage over the existing protocol is to achieve high packet ratio by avoiding high packet drop rate paths. This should achieve a reliable communication and enhance the lifetime of network by this method.

III. SIMULATION

To create a faulty node environment we use AODV protocol and create an environment using 10 nodes. The network parameters are shown in the table 1. With the figures we have tested the performance of AODV protocol for the parameters throughput, end-to-end delay and residual energy which are the mostly considerable parameter in WSN.

PARAMETERS	VALUES
BROADCAST POWER (WATT)	1.8
FREQUENCY (HZ)	2.472×10^{9}
INITIAL NODE ENERGY (JULES)	100
THRESHOLD VALUE DURING COLLISION (DB)	100
THRESHOLD VALUE OF CARRIER SENSE (WATT)	5.011872×10^{-12}
THRESHOLD VALUE OF RECEIVE POWER (WATT)	5.82587×10^{-09}
POWER CONSUMPTION DURING IDLE(WATT)	712×10^{-6}
POWER CONSUMPTION DURING RECEIVING OF THE INFORMATION (WATT)	35.28×10^{-3}
POWER CONSUMPTION DURING TRANSMISSION OF THE INFORMATION (WATT)	31.23×10^{-3}
POWER CONSUMPTION DURING THE SLEEP MODE (WATT)	144×10^{-9}
TIME OF SIMULATION TIME (SEC.)	10
NUMBER OF SENSOR NODES DEPLOYED IN NETWORK	10

Table 1: Simulation parameters used in AODV

Figure 1 describes the communication scenerio which is used in the proposed system. There are 4 anchor nodes are deployed at the corners. Some nodes are deployed between them randomly.

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The transmission of packets from one anchor node to anchor node is displayed in this figure. In this one will act as sink and other is source node.Node 6 and node 5 are respectively used as source and sink.After the transmission every node in the transmission path will lose some energy. Due to continuous energy loss of a particular node will become faulty.so that node will identified as the faulty node and ensure the network become stable.

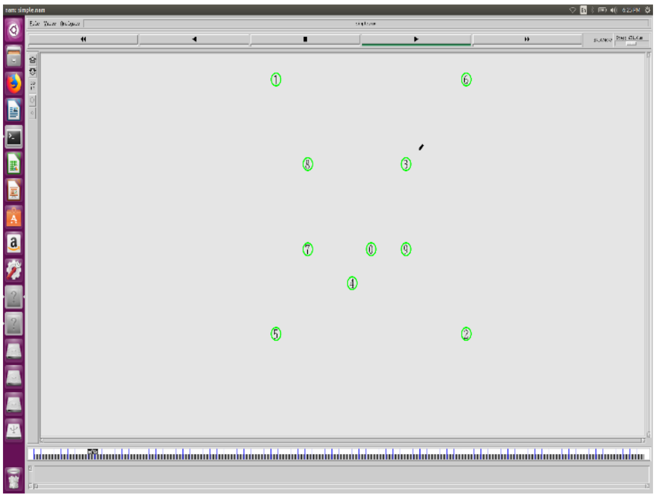

Fig1. Creation of sensor nodes

Simulation is conducted on the simulation over 10seconds and results are described in the subsequent figures which shows variation of network parameters with respect to times.

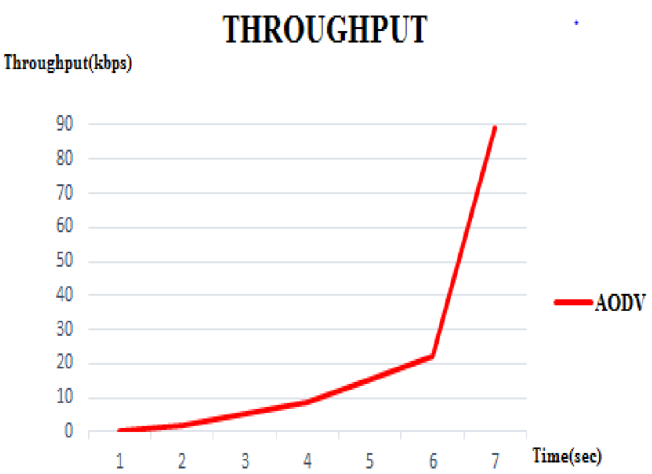

Fig2. Throughput of AODV

Figure 2 shows the throughput of the WSN in that communication link from the sink and source node. There is a slight variation in rate of packets delivered at the sink node. If a faulty node in the communication path occurs then the rate of packets delivered decreased. Due to this it affect the throughput in the communication path between source and sink.

Throughput=PacketsDelivered/Propagation Time

Below figure 3 shows the average residual energy of each node after the transmission of packets. The residual energy will be reduced by the presence of any faulty node in the network. If any faulty node occur in the network it will also affect the working of other node in that network. Due to that reason nodes lose more energy for the frequent transmission of data packets.

Residual Energy = (Initial Energy - Transmission Energy) / Number of Nodes in Transmission Path

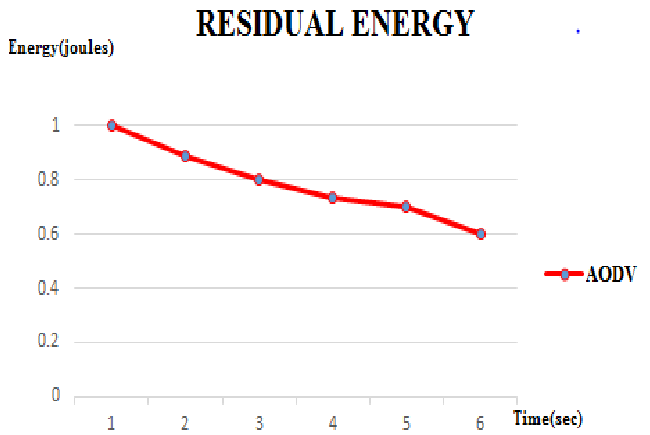

Fig3. Average residual energy of AODV

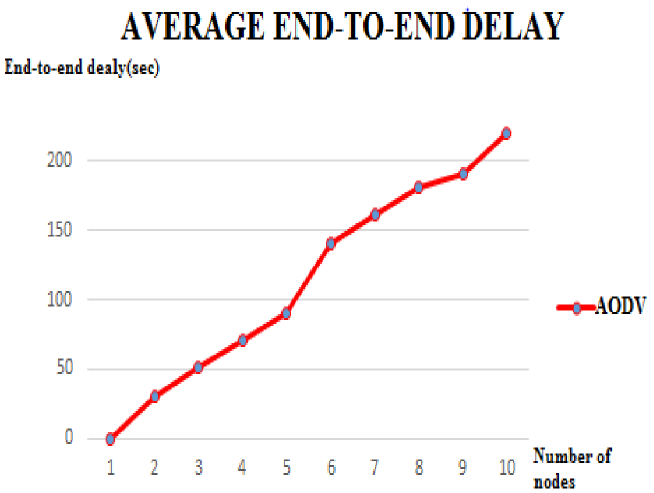

Fig4. Average end-to-end delay of AODV

Figure 4 shows the average end-to-end delay from the source to sink node. The presence of faulty node may delay the transmission of packet delivery. By that the packet will take more time to reach destination.

Average End-To-End Delay=Total End-To-End Delay / Number of Nodes in Transmission Path

Above figure 2, 3 and 4 are the output graphs of AODV routing protocol. In this work, assumption is that any faulty node in the transmission path these will affects the following characteristics. By the continuous usage of node will reduce the residual energy of node. The faulty in a network increases the end-to-end delay from source node to sink. Any faulty node come into the path of communication between

IV. PROPOSED METHODOLOGY

The studies carried out on the literature survey gave an idea ofthe variant faults in a network

4.1. Defining faulty node

In the existing simulation model faulty node is detected according to the less residual energy than the usual nodes. In NS2 energy model can be described such parameters. In this proposed work, assuming that the faulty nodes any how last its energy due to some reason and when its energy go beyond a threshold value the node is not able to transmit the data packets or any communication packets to its neighbour. It is general convention that every nodes are having a minimum transmitting power that enable the nodes to communicate with its neighbour. In this work identifying the faulty nodes by its surrounding nodes. Now if any faulty node come into the path of communication between source and sink throughput may be decreased or end-to-end delay may be increased. In our proposed algorithm we are checking the two parameter energy values of individual nodes and the end-to-end delay of any specific path to find out the optimal path. We also check the optimal path for communication by measuring the average energy consumption of the communication. The subsequent section describes our proposed algorithm for finding the faulty nodes.

This proposed method creates a network using four anchor nodes and six other node. Two nodes will be selected as source and sink node. Here messages will be passed from source to sink node. Initially energy will be same for all the sensor nodes in the network. During transmission some energy will be utilized. Due to continuous passing of packets the nodes energy will be exhausted. So it will be a faulty node.

4.2. Proposed algorithm

To check failure node on basis residual energy of node

Input: Residual energy
For any pair of source and sink
Find set of possible paths from source to sink
For i<=0 to count (generated paths)
Check energy level of nodes after each transmission
Compare energy of each node according to require energy to communicate
If (Transmission Energy>Residual energy)then
Failure detected
else
Set path for transmission
end if
end for

To check failure node on basis of delay

Check the average time delay of transmission
If (delay> average delay) then
Send packets through currently optimised path
else
*TTL=average delay *(packet_delivered/packet_send)*
If(TTL>average delay))
failure detected
use backtracking techniques for the lost data from failure nodes
else
remove node from the network
end if

V. CONCLUSION AND FUTURE WORK

In this paper we have implemented WSN using NS2. We have also used AODV routing protocol for testing the communication path. Graphically we tried to understand the performance of AODV. We also describes how to create a faulty node in WSN and moreover how to find out the faulty node theoretically described. We consider two different parameters residual energy and end-to-end delay for finding the faulty node. In future the authors will test the algorithm for finding the faulty nodes in WSN.

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