Energy Efficient Route Recovery Process in Mobile Sensor Network by using Check Point Route Recovery (CPRR) Algorithm Based on AODV Routing Protocol

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Abstract- Wireless sensor network (WSNs) is a wireless sensing and perform processing tasks in tiny nodes called sensors. Mobile Ad-hoc Sensor Network (MSN) recently launched a growing popular class of WSN community in which mobility plays a key role in the execution. Mobile Sensor Network is monitoring on mobile nodes, design a cellular automaton based algorithm. In this paper mobile sensor nodes to node blocking, node monitoring and disconnect communication link failure problem rectification in sensor network. The energy consumption and energy drain of sensor node performing better route recovery process based on AODV protocol and Check Point Route Recovery (CPRR) Algorithm on Mobile Sensor Network. CPRR can reduce link failure and route recovery process based on energy efficiency of sensor node to prolong the network lifetime. Finally, CPRR and AODV is simulated and evaluated to other energy efficiency routing protocol performs different parameter metrics comparison results by NS-2 simulator.

Keywords – WSNs, MSN, AODV, CPRR, Energy Consumption, NS-2.

I. INTRODUCTION

Mobile Sensor Network (MSN) recently launched a growing popular class of WSN community in which mobility plays a key role in the execution [1]. Mobile nodes monitoring in a Mobile Wireless Sensor Network. We design a cellular automaton based algorithm for monitoring mobile nodes in an MSN restricted to a transmission range. To the best of our knowledge, this is the first cellular automaton based algorithm for communication in mobility problem. The mobile sensors are initially deployed in a square block where all the nodes are monitored by at least one of the mobile sensors. However, when the mobile nodes start moving they might not be monitored. For this reason, the mobile nodes also need to move and we design a new movement algorithm Note that, we consider the speed of the mobile nodes to be higher than the mobile sensors. Otherwise, the problem becomes trivial. We compare our new algorithm in terms of the percentage of the nodes monitored with the increase of time and find that after a certain period of time this number becomes almost static and we can monitor a good portion of the nodes continuously. We consider the Check Point Route Recovery Algorithm (CPRR) algorithm designed for the link failure route recovery of mobile sensor networks to compare AODV and Pro-AODV algorithms perform well in this particular problem compared to our CPRR algorithm. The Mobile sensor has wireless communication capability and some level of intelligence for signal processing and networking of the data. In a static sensor network, due to node failure, the network can be disconnected. Mobile sensors can be used to re-establish the connectivity of the network. If the sinks of the network are stationary, then due to the traffic load, the sensors close to the sinks can die earlier. Introducing mobility to the sinks can solve this problem by using AODV [2] routing protocol, Check Point Route Recovery Algorithm and based on energy efficiency of sensor nodes. Mobile Sensor Networks support some specific applications like Sensor can be attached to unknown vehicles for surveillance, Sensors air quality and environmental monitoring, Track their movements of Animals migration patterns, feeding habits, emergency search and rescue operations, Military battlefields among troopers to coordinate defense or attack, and Medical health care.

The rest of the paper is organized as follows. Related work discuss in section II. Proposed embedding and extraction CPRR algorithm is explained in section III. Experimental results are presented in section IV. Concluding research work is given in section V.

II. RELATED WORK

Wireless communication network can be classified two types: infrastructure and infrastructure less networks [3]. Infrastructure-less networks have no central controller means no Access point. MANET is self-configuring network which is infrastructure less in nature and Mobile Sensor Network (MSN) is collections of sensing device that can be wirelessly communicate with each other. Link failure is a main problem in MANET which is responsible for the degradation of the network and packet lost. To avoid link breaks in an active node take updating route table entry and new route recovery initiated with the support an intermediate node. Same way in Mobile Sensor Network (MSN) consider sensing action mobile actor nodes disconnection of links in node. Static and Dynamic sensor nodes to develop link failure process in actor nodes with the help of energy of sensor node. Energy efficiency of sensor node to maintain backup of node and link between two or more sensor nodes. This research work paves way for improving the route establishment process of mobile sensor networks through two different approaches based on energy level of sensor nodes. A major challenge that a routing protocol designed for ad hoc wireless network faces is resource- constraints [4]. One of the most critical issues in mobile ad hoc networks is link failure prediction. Since mobile nodes usually operate on intermediate node connection in ad hoc fashion. MANET routing protocols include performance under various network environment, traffic conditions, maximizing network throughput, lifetime and minimizing delay. Network efficiency is usually measured by life time, packet delivery ratio and energy consumption.

A lot of research work has been carried out in this domain. Reuven Cohen and Boris Kapchits [5] "Energy-Delay Optimization in an Asynchronous Sensor Network with Multiple Gateways", The problem in this paper is constructing efficient routing trees and the problem of wake up frequency assignment in a network with multiple routing trees. Sayid Mohamed Abdule, Suhaidi Hassan e.tl. [6], has proposed by a Divert Failure Route Protocol Schemes as a solution to link failure. DFRP tries to avoid a link failure in advance. K.A.Shah M.R.Gandhi [7], focus on the performance of AODV routing algorithm with reference to local route repair techniques of link route repair.

III. PROPOSED ALGORITHMS

A. Pro-AODV Algorithm

Proposed AODV (PRO-AODV) to improved optimizing routing process to make more extensive use AODV Routing Protocol [2] in Mobile sensor networks. The routing table in PRO-AODV maintains only one route to the source node and the destination node needs to re-initiate the route discovery process as a route fails. The link failure of route recovery process to solve this problem, an improved AODV method is presented. Whenever there is a link failure detected. Link failure is appears while forwarding route request messages. The nearest neighbour node has taken backup of particular failure node. A backup routing table is built when the node movement speed is less than a threshold value. The route repair of the links based on energy level of sensor nodes in mobile sensor network. The improved or PRO-AODV mechanism using maximum and minimum energy consumption of sensor node, which is shown in various performance metrics experimental results analysis.

B. Check Point Route Recovery Algorithm–

Check Point Route Recovery Algorithm (CPRRA) calculates the energy level of each node by sending heart beat messages. Actors will periodically send heartbeat messages to their neighbors to ensure that they are functional, and also report changes to the one-hop neighbors. Missing heartbeat messages can be used to detect the failure of actors. Once a failure is detected in the neighborhood, the one-hop neighbors of the failed actor would determine the impact, i.e., whether the failed node is critical to network connectivity. This can be done by executing Check Point Route Recovery Algorithm. Basically, a cut vertex F has to be on the shortest path between at least two neighbors of vertex F. The Check Point Route Recovery Algorithm serves the shortest path of all nodes. The static node monitors all the nodes and detects which node's energy is about to drain. After detecting, the Static node intimates the dynamic node that energy of a particular node is going to drain. The dynamic node selects another node having higher energy level to get the back up and to replace that particular node. NTM- Network Topology Management is used to maintain a link between the nodes when energy loss is detected in a node. AODV- Ad-hoc on demand Distance Vector protocol is a reactive type of routing protocol. It is used to calculate the shortest path for communication between nodes. The static node and the dynamic node are the main functionalities done with the help of check point route recovery CPRR algorithm.

- Actuator Node

- Static Sensor node
- Dynamic Sensor node

A. Actuator Node

An actuator node is a Sensor Node is capable of performing sensor processing, gathering sensor information. The nodes communicate wirelessly after being deployed in sensor network. It will periodically send messages to one hop count their neighbors. Missing messages can be used to detect the failure of actor nodes. Once a failure is detected in the neighborhood then one hop neighbors of failed actor would be determine. The impact of the failed actor node is critical to network connectivity. The CPRR Algorithm serves the shortest route of all nodes.

B. Static Sensor Node

In this sensor network a delay in messages or missing of messages, then the static sensor nodes detects the energy drain in that particular node. The main functionality of static sensor node is to detect energy loss in a particular node and whose node energy loss to intimate the dynamic sensor node.

C. Dynamic Sensor Node

The Dynamic sensor node selects a node whose energy is high and who has less links. The Dynamic node replaces the node with the failure node after taking backup. The Dynamic node after receiving the information searches for a node which is nearest to the failure node and whose energy is high. The dynamic sensor node selects a node for replacement based on priority. After the failure node has regained all its energy it will come back to its position.

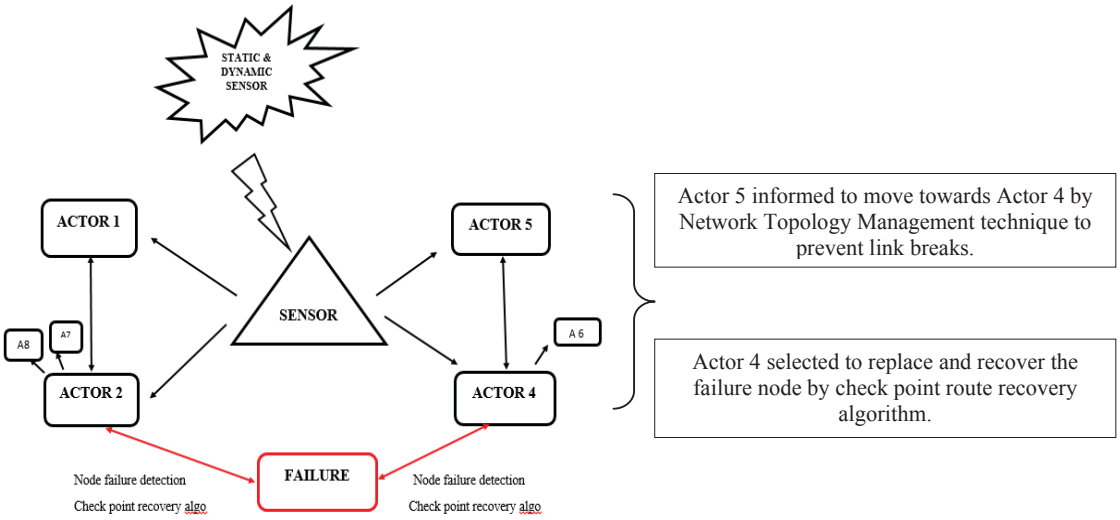

Figure 1. Check Point Route Recovery Algorithm System Archetecture

Once there is a delay in heart beat messages or missing of heart beat messages, then the Static nodes detects the energy drain in that particular node which drops or delays the heart beat messages. The Static node after detecting the energy drop in a particular node intimates the dynamic node. The Dynamic node which is in mobility searches for a node which is nearest to the failure node. The Dynamic node finds a node whose energy level is high and who has lesser links when compared to other nodes. When the dynamic node replaces the failure node with another node, that node takes all the back up from the failure node. It also helps in the functioning of static and dynamic sensor nodes. The main functionality of static node is to detect energy loss in a particular node and to intimate it to the dynamic node. The Dynamic node selects a node whose energy is high and who has lesser links. The Dynamic node replaces the node with the failure node after taking backup.

SELECTION OF NODE FOR REPLACEMENT

A node is selected for replacement only if that node is nearest to the failure node. The node which is selected for replacement should have high energy and should be nearest to the failure node. The selected node for replacement should have lesser links. The Static node monitors whose energy is about to drain. If the static

node detects energy loss in a particular node then it informs the dynamic node that a particular nodes energy is about to drain. The static node intimates the dynamic node using signals. The Dynamic node after receiving the information searches for a node which is nearest to the failure node and whose energy is high. The dynamic node selects a node for replacement based on priority. The dynamic node replaces this node with the failure node. The node which replaces the failure node gets back up from that node. The node which took back up will do all the functionalities of the failure node until the failure node has retained energy. After the failure node has regained all its energy it will come back to its position. The energy loss of each node is detected by the static node. The static node and the dynamic node are the main functionalities done with the help of check point route recovery algorithm.

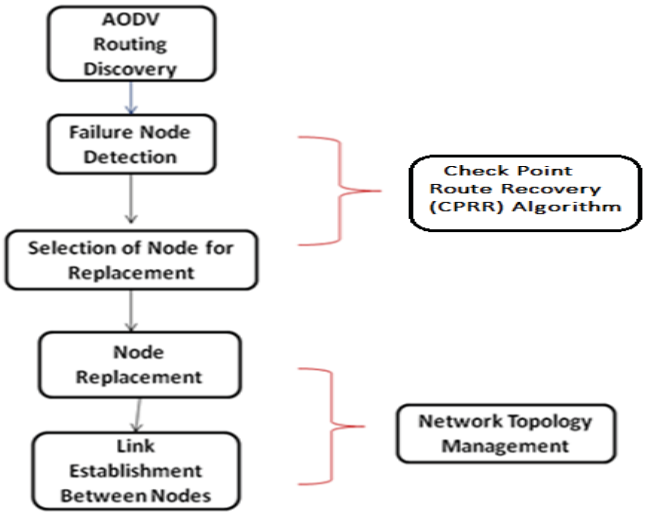

Figure 2. Check Point Route Recovery Algorithm Block Diagram

NODE REPLACEMENT

The node replacement is done by Network Topology Management (NTM). The Network Topology Management helps maintain the link between the nodes. It maintains the link between the nodes when energy loss is detected in a node. During replacement there are possibilities for direct links between nodes to break NTM helps maintain the link. It maintains the link between the nodes without affecting the packet transmission. The selection of the node for replacement is based on priority which has less number of links connected to it with higher energy level. Based on this the nodes are replaced and back up is taken. The failure node selects a node which has lesser links connected to it. Once it regains its energy it returns back to its normal position. This process takes place continuously.

Check point Route Recovery Algorithm (CPRRA) is used to detect the energy drain in a node, before the energy of that node is completely drained. Reactive type of routing protocol refers to simultaneously selecting the best path between the source and destination on demand. The Static sensor monitors each and every actor nodes and if there is energy loss in any node then it intimates the Dynamic sensor node. Dynamic sensor to finds the nearest node whose energy level is high and has the lowest number of links. This actor node then replaces the failure node using the CPRRA. The Network Topology Management (NTM) helps maintain the link between the nodes. The links of the node which replaces the failure node is maintained with the help of NTM. It maintains the link between the nodes when energy loss is detected in mobile sensor network. The CPRRA work improves the route establishment of Mobile Sensor Network and also reduce link failure problem. The proposed methodology is expected to produce better results when compared with PRO-AODV methods

IV. EXPERIMENTAL RESULTS

In this section, the simulation evaluations in NS-2[8] Network Simulator and Linux Mint (17 version) operating software will conducted to perform an experiments and results analysis on the performance ability of CPRRA algorithm with the discussed mechanism. We designed and implementation our test bed using Network

Simulator to test the performance of both (AODV, Pro-AODV) routing protocols, simulate and compare various performance metrics.

The simulations have been performed using Network Simulator 2 version 2.35 a software that provides scalable simulations of wireless ad hoc sensor network and open source software. In our simulation node energy power transmission details and parameter has shown in Table 1. Define option for simulation environment various distribution in wireless transmission network area. The initial energy of sensor node is 100 joules and Transmission power, received power. The total simulation time is 150 second.

Table -1 Simulation Parameter values

Parameters	Values
Network Range	1000*1000 m
Data Packet Size	512 Bits
Routing Protocol	AODV
Initial Energy	100 joules
Tx power	35mW
Rx power	40mW
Simulation Time	150 sec
Number of nodes	30, 50, 70,100
Pause time	10 sec

First we describe how the trace files, NAM file is generated the perl script file writing in .gawk file extension to generate simulation results and Xgraphs is plotted in given simulation network environment. The performance metrics of sensor node is energy consumption, detection time, and energy drain rate of all actor, static and dynamic sensor nodes values grabbing with the support of writing perl script file to generate results using NS2 simulator.

4.1. Simulation Network Environment

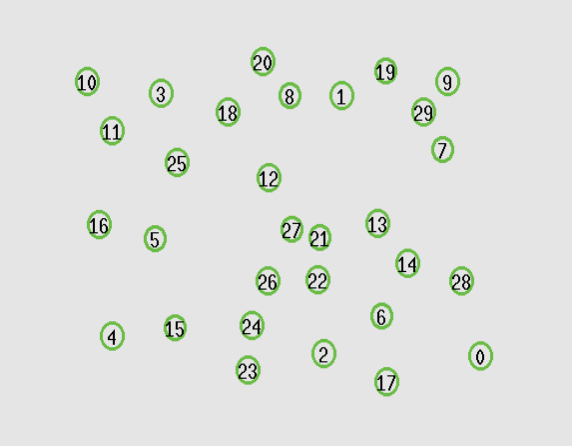

Figure 3. 30 nodes created from 0 to 29 places at random distance.

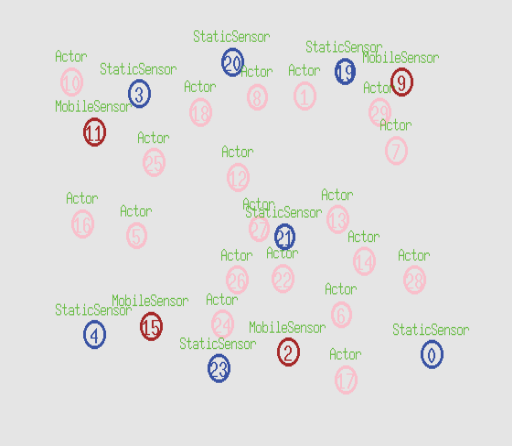

Figure 4. pink, blue and brown color nodes represent actor node, Static node, and Dynamic nodes

4.2. Performance Parameter metrics

i. Detection Time Analysis

Detection time is the time it takes to find an optimal path and is given by the time at which the route is found was subtracted from the start time of route discovery.

Detection Time=Route Discovered Time-Initial Time

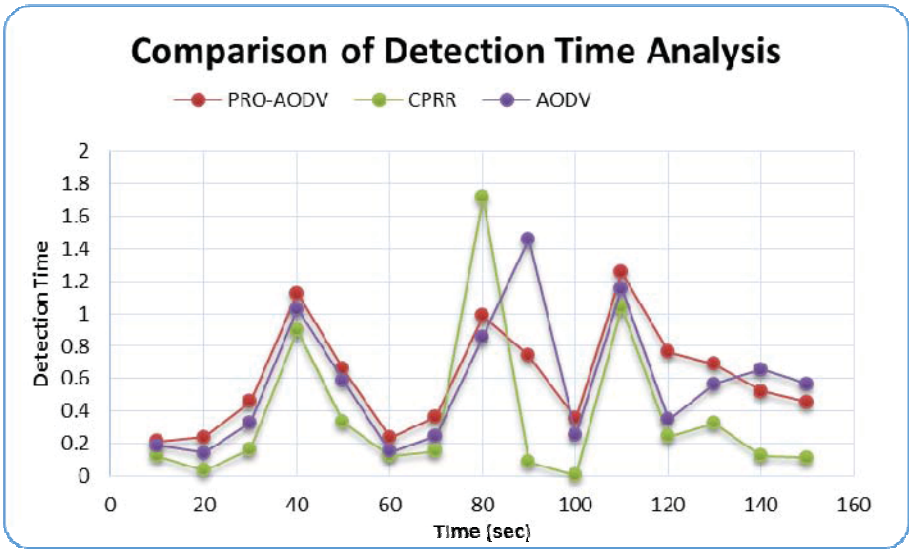

Figure 5. Comparison for Detection Time Analysis

The time detection analysis includes processing and queuing delay in each neighbor node i.e. the time elapsed until a demanded route is available. The CPRR algorithm takes low time of route established and fast recovery of route process is better performance of other AODV and Pro-AODV algorithms.

ii. Energy Consumption with Respect to Time

This calculates the total energy consumed by the node with respect to time.

Energy consumption=Initial Energy- Present Energy

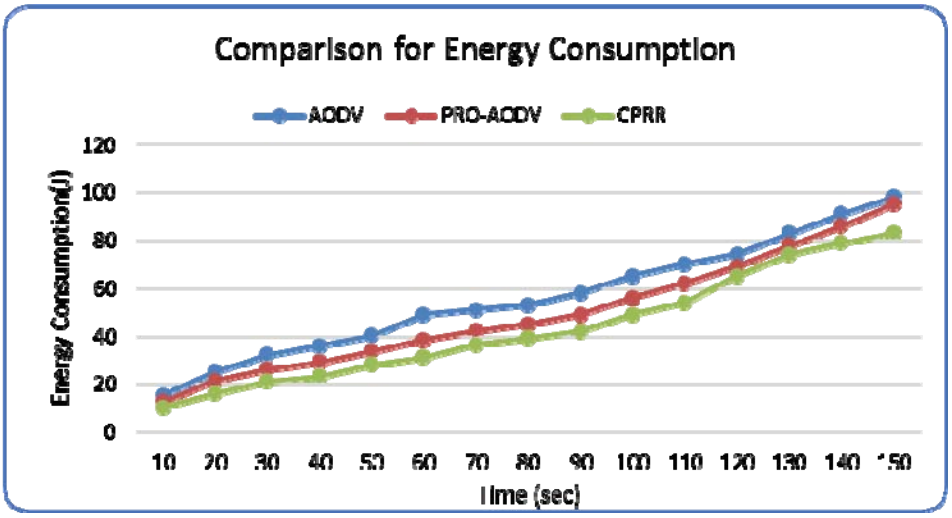

Figure 6. Comparison for Energy Consumption

The energy consumption analysis includes every neighbor nodes i.e. the time increases energy conservation also increases. The AODV and Pro-AODV algorithm energy consumption is more better performance in CPRR algorithm and fast recovery of route process is establishment in mobile sensor network.

iii. Energy of Draining Rate

Calculation of energy draining rate for different nodes like actor, static and dynamic nodes.

The particular node energy draining rate is calculated by,

$$E_{DR} = E_{initial} - E_{remain\,/\,(Tc\,-\,Tp)}$$

E_{DR} is Energy of Draining Rate

$E_{initial}$ is Initial energy of particular node

E_{Remain} is Remaining energy of Particular node

Tc – current time.

Tp - previous time.

Energy draining rate of all sensor nodes with time increases drain rate is decreases in every individual sensor nodes and result is found in dynamic sensor node more energy consumption taken.

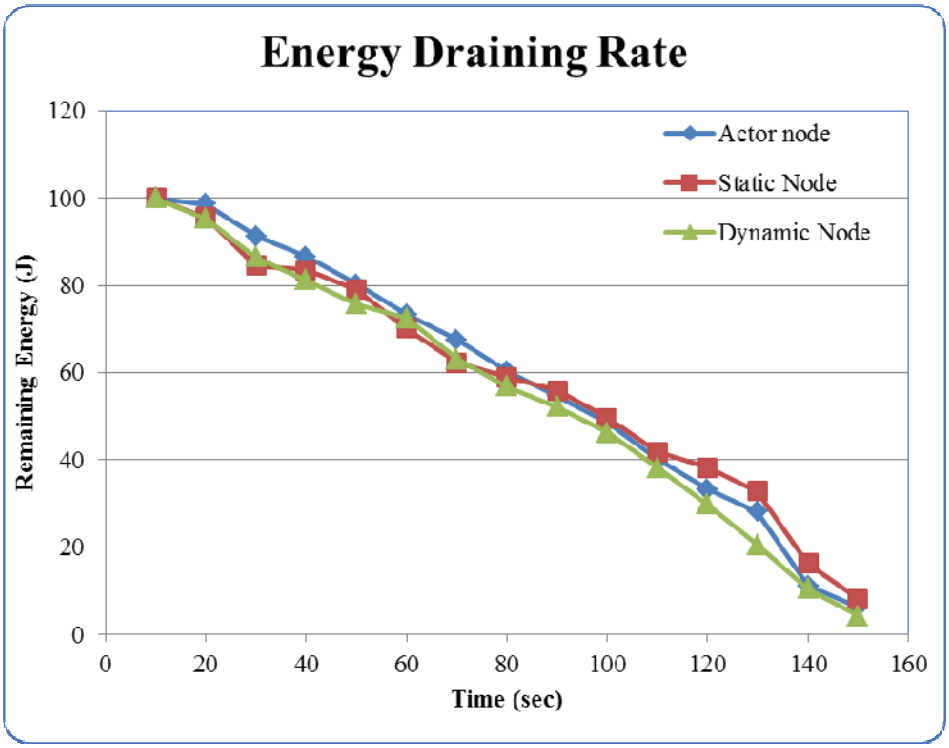

Figure 7. Comparison for Energy Drain Rate of all sensor nodes

The simulated results shows that the improved AODV protocol and CPRR algorithm can reduce the energy consumption effectively, and also decrease detection time analysis for overall performance in different algorithms. The simulation environment generating better results while combining Check Point Route Recovery (CPRR) Algorithm compare with other improved or PRO-AODV algorithm, and also it may be effective better results generated. The CPRR Algorithm is more better than AODV and Pro-AODV algorithm results.

V. CONCLUSION

Mobile Sensor Network is monitoring on mobile nodes, design a Check Point Route Recovery (CPRR) Algorithm. In this paper mobile sensor nodes to node blocking, node monitoring and disconnect communication link failure problem rectification in sensor network. The performing route recovery process of link failure problem fast recovery based on energy efficiency of sensor node and Check Point Route Recovery (CPRR) Algorithm on Mobile Sensor Network. The performance of parameter metrics such as energy consumption, energy drain rate and detection time analysis of sensor node better results compare to other routing protocols. The CPRR and AODV is simulated and evaluated to other energy efficiency routing protocol performs different parameter metrics comparison results by NS-2 simulator. This result in a Reliable, Robust and energy-efficient communication between the sensor nodes. The future scope research for improving in finding the best route and energy efficiency of the sensor nodes.

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