

## Recovery and Replacement Algorithm for a Wireless Sensor Network

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### Abstract

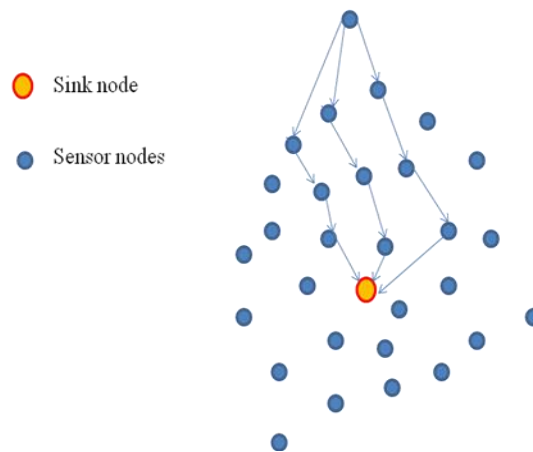
*In this paper we proposed a recovery and replacement algorithm mainly used to increase or strengthen the life of a sensor node when they complete the battery power. In generally wireless sensor network consists of lot of sensor nodes, hundred(s) or thousand(s) of nodes form a network to transfer the data from source node to sink node. The sensor node lose their battery power when it is used for long period of time, so it is difficult to recharge nodes of the sensor and also main in wireless sensor network is reduce the data loss, energy consumption and recovery and replace the effected nodes. So here we proposed a recovery and replacement algorithm which is a combination of genetic algorithm and grade diffusion algorithm. Here each node contains either two values those are binary values 0, 1. 1 means battery life greater than the threshold values otherwise it will be 0. This approach is better than existed algorithms, the number of faults decreases, reduces the data loss up to 98% and reduce energy consumption to 32%.*

**Keywords:** *Wireless sensor, source node, sink node, diffusion, threshold, genetic algorithm*

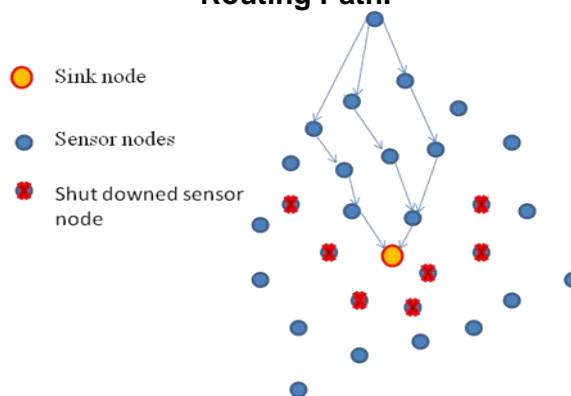
### 1. Introduction

Generally wireless sensor networks have lot of sensor nodes each node have some limited battery power and node loses the battery power it uses long time. A review of current routing protocol for a ad-hoc mobile network [3]. In this battery and wireless technology sensors have intensify the data processing and also this wireless technology having the wireless detection technique, wireless communication. Generally every sensor node has some battery power for transmit the event data to the base station to the sink node. The wireless sensor network ordinarily encompasses many sensor nodes. Whenever we use the sensor nodes it loses some battery power that we cannot get back and also energy of sensor node will be drained when transmission process is running. If the energy of sensor node is drained, wireless sensor network exposure will come out. Event data not transmit through the network from source node to sink node. Due to this relay other sensors will be burden so more transmission occurs for other sensors. In this paper proposes an algorithm recovery and replacement algorithm that increases the

strength when sensors nodes are shutdown i.e. sensor nodes do not have battery power and sensors. When life time reaches their optional threshold value RRA algorithm replace the those sensor nodes used the reused routing paths but not only replacement is also reduced. Improves the wireless sensor network lifetime and diminish the sensor node drained cost. In fig 1 and fig 2 shows the wireless sensor network's functioning and non functioning and how the event data can transmit source node to sink node.



**Figure 1. Wireless Sensor Nodes are Functioning and that having the Routing Path.**



**Figure 2. Some of Sensor Nodes are Nonfunctioning in Network that are in the Routing Path**

## 2. Related Work

Previously wireless sensor network proposes lot of routing algorithms and energy algorithms. This project is also continued after observe the previous methodologies are helpful to provide effective communication and efficient energy to a sensor network nodes. Generally wireless sensor contains lot of sensor nodes armed with computing and sensing and communication devices over wireless channels. The main aim of WSN is to collect event data from the source and send it to sink node. In previously used two algorithms are directed diffusion algorithm and grade diffusion algorithm [9]. In this grade diffusion algorithm used finding the grade each and every node also find the nearest neighbor nodes and generates the routing path for each and every sensor node. These developments are will finally improve the life time and drain the sensor node cost of replacement. Next concept of genetic algorithm developed from the M. Gen and R. Cheng, [4]. This genetic algorithm is used to generate an efficient node from the dead nodes.

### 3. Directed Diffusion Algorithm

Directed diffusion algorithms in C. Intanagonwiwat et al. presented the Directed Diffusion (DD) algorithm [7] in 2003. The main goal of directed diffusion algorithm eliminates the data relay .because of this relay lot of power will consumed. The event data not sent to sink node the source node will board cost route request packets to all neighbors nodes and this process will continue until the all route request packets are collected by sink node. Here use the query driven transmission protocol. The data will be sent only if it matches the query from sink node.

### 4. Grade Diffusion Algorithm

Grade diffusion algorithms proposed by H. C. Shih et al. in 2012 to improve the ladder diffusion algorithm using colony optimization for wireless sensor network for wireless sensor network[6]. The grade diffusion algorithm main aim is reduce the transmission loading due to find the set of neighbor node and also creates the routing path for each and every sensor node. Each sensor node takes the other sensor node from the set of neighbor nodes. When grade table is absent a node is able to perform relay. The grade diffusion algorithm also records the information about data relay. The GD algorithm updates routing path real time. So due to this operation the data will transmitted to sink node fast and accurately. Fig 3 shows flow chart of grade diffusion algorithm step by step process.

The main aim of grade diffusion algorithm is find grade for each sensor node then after fetch the routing table then take the node from surrounding coverage area then check if neighbors contain destination next fetch nodes in forward direction and then pick the node form forward direction and finally again go the another source node this process continued until it find all nodes. The flow chart of grade diffusion algorithm is given below. The wireless sensor network may fails due to verity of reasons that are the sensor networks might a break; the sensor networks might a leak, Due to long use of sensor it loses their life time. So need more relay nodes in wireless sensors network sensor have power consumptions is unstoppable.

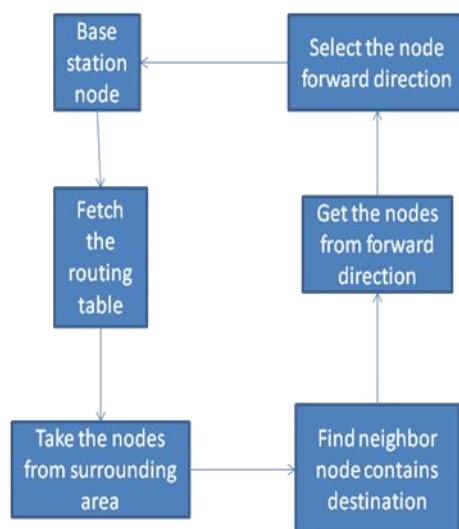


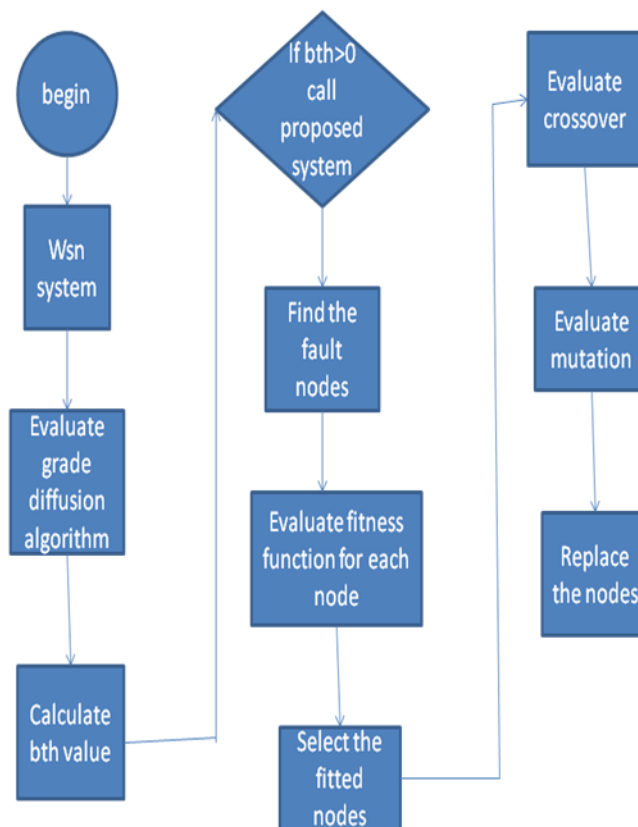
Figure 3. Flow Chart of Grade Diffusion Algorithm

### 5. Recovery and Replacement Algorithm

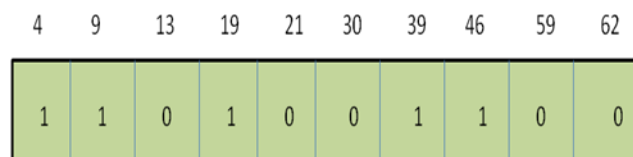
This paper proposes RRP algorithm on grade diffusion algorithm combine with the genetic algorithm for reinstating the sensor nodes when some of the sensor nodes are

shutdown. This algorithm can give the minority of replacing sensor nodes and also more used routing paths named as RRP. This algorithm generates the grade number and routing table, a set of acquaintance nodes and payload value each sensor node. The node deportation the live data to the sink node according to the grade diffusion algorithm when event occurs here finds the  $B_{th}$  value.  $B_{th}$  value larger than the RRP algorithm will be conjured; reinstate the dead node by the best fitness nodes that is generated by genetic algorithm using the some operations to reinstate the sensor nodes. Fig 4 shows the flow chart of recovery and replacement algorithm of wireless sensor network step by step process as follows.

There is another specification that is that lies between (0, 1) that is set by the user.  $B_{th}$  Value calculate according to the formula [1]  $B_{th}$  value greater than the 0 it can go to the genetic algorithm and the perform process of genetic algorithm and replace the very effective sensor node from dead node. After completion of  $B_{th}$  value of all nodes dead nodes or less life nodes are sending to the genetic algorithm. Remaining nodes are functioning normally.



**Figure 4. Recovery and Replacement Algorithm Flow Chart**



**Figure 5. Structure of Chromosome and its Genes**

$$B_{th} = \sum_{i=1}^{\max(\text{grade})} T_i$$

$$T_i = 1 \text{ is } \frac{N_i^{now}}{N_i^{original}} < \beta$$

$T_i = 0$  other wise

$N_i^{now}$  = Total number of sensor nodes in network with grade at  $i$ .

$N_i^{original}$  = Total number of sensor nodes that are functioning currently with grade at  $i$ .

### 5.1. Initialization

Initialization process is primary step of genetic algorithm. This initialization step based on the network population of network. Here generate the chromosome and that is formulated with the 0 and 1. In the chromosomes all the nodes are effected nodes or dead nodes. The number of chromosomes are depends on population size which is specified by the user shown in Figure 6.

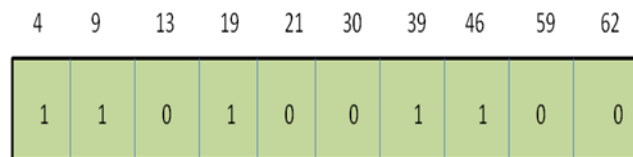


Figure 6. Chromosomes and its Gens

### 5.2. Evaluation

Genetic algorithm second step is evolution here find the fitness of each node. Fitness can be identified by fitness function. Here find the dead nodes of fitness by using below function. RRP algorithm main aim of reinstate the fewer sensor nodes and diminish the cost of replacing sensor nodes.

$$fn = \sum_{i=1}^{\max(\text{grade})} \frac{P_i \times TP^{-1}}{N_i \times TN^{-1}}$$

$N_i$  = the number of reinstated sensor nodes and their grade value at  $i$ .

$P_i$  = the number of re-usable routing paths from sensor nodes with their grade value at  $i$ .

$TN$  = total number of sensor nodes consists the wireless sensor nodes

$TP$  = total number of routing paths consists the original WSN.

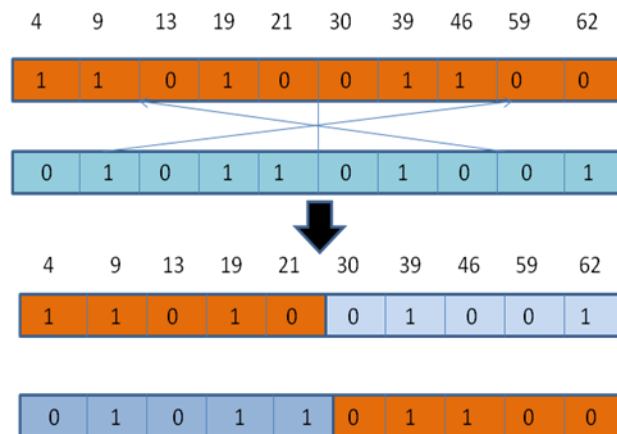
### 5.3. Selection

Selection step will be done after the evolution. Here eradicate the lowest fitness value nodes and those are contains the rest. Initially obsolete nodes are deleted remaining nodes place into the mating pool and next better fitness nodes send to the cross over step. That will be generated a best fitness nodes.

### 5.4. Crossover

The name itself indicates cross over step is crossing operation apply on two chromosomes that will generate the new chromosomes. Here use the one point cross over strategies is used to develop the new chromosome. The new chromosome is

developed swapping of two chromosomes and generate the new best chromosome node. Figure 7 shows cross over step how the new chromosome can generated.



**Figure 7. Cross Over**

### 5.5. Mutation

Mutation step after perform the crossover it generate the best fitness chromosomes that are very fast and effective. The chromosome can modify by mutation that just flip the one node to the 0 to 1. After the mutation step the changing chromosome are very effective compare to the previous chromosomes. This is final step of the genetic algorithm after this the node can be replace the dead node position.



**Figure 8. Mutation**

## 6. Simulation

The simulation of RRP algorithm construe in the above section has been implemented to check the methods and results. In simulation discuss the three main criteria's i.e. energy consumption, data loss, recovery of dead nodes.

How much better than the proposed system compare to the existing system shown below.

### 6.1. Energy Consumption

Initially each and every node has same battery power. After some operation or some iteration, the node will lose some power and also some energy. The loss of energy during process is called energy consumption. Energy consumption is better than the grade diffusion algorithm and directed diffusion algorithm. Below graph show the difference.

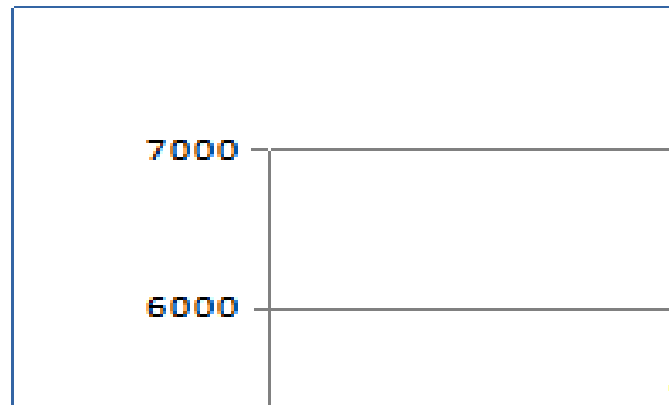


Figure 9. Comparison of Energy Consumption

### 6.2. Active Nodes

The number of active nodes is high in the RRP algorithm. Here it uses grade diffusion combine with the genetic algorithm. For improve the number of active nodes in wireless sensor network. Initially each node has some battery power due to long use or due to some operations the battery of sensors drained. So using the RRP algorithm the number active nodes increased drained data loss.

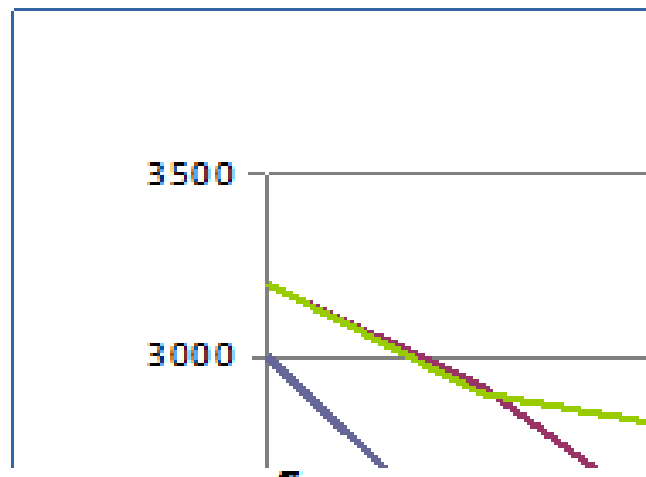
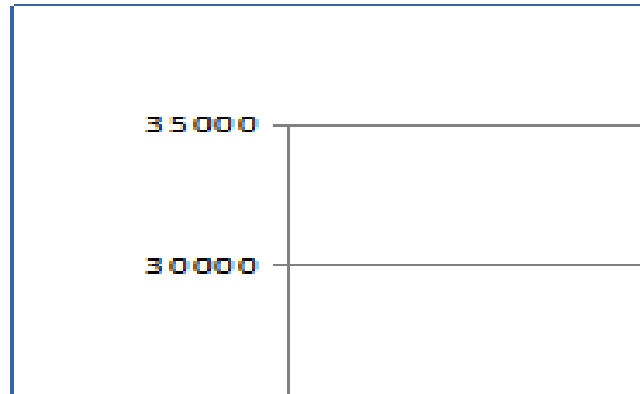


Figure 10. Comparison of Number of Active Nodes

### 6.3. Data Loss

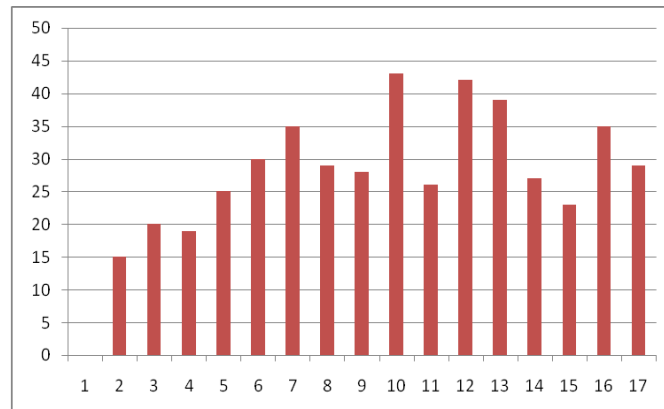
Data loss depends on the functioning nodes in the wireless sensor network. In the network number of faults is increases the data loss will be increases. Data and number of faults are directly proportional to each other. RRP Algorithm gives the better than the existed system. Data loss will be drained when compared to the directed diffusion algorithm and grade diffusion algorithm. Below graph show the difference.



**Figure 11. Comparison of Total Data Loss**

#### 6.4. Recovery of Dead Nodes

Recovery of dead nodes by using RRP algorithm that is implemented by using the grade diffusion algorithm combined with genetic algorithm. These two algorithms are very useful to recovery the dead nodes. Genetic algorithm generate the new nodes by using five steps Initialization, evolution, selection, cross over, mutation recover the dead nodes.

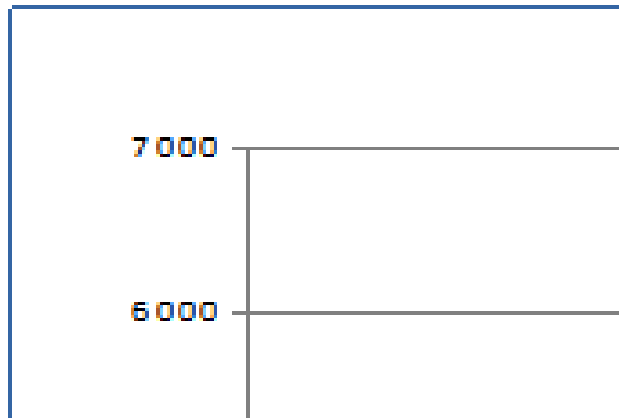


**Figure 12. TotalNumber of Dead Nodes Recovery**

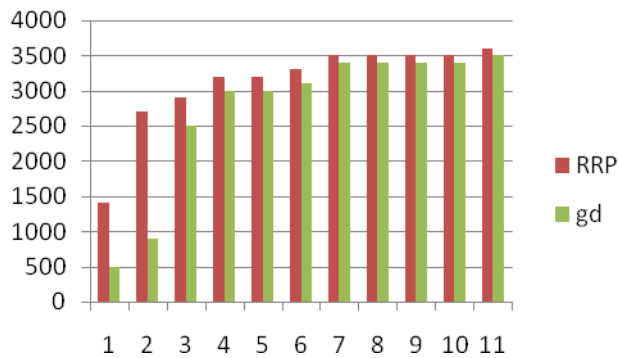
In the same way average number of messages received to sink node is high, because data loss is very low in RRP algorithm.

Average residual energy is high in the RRP algorithm compare to the grade diffusion algorithm. Below graph are show the average residual energy after the 7000 events and average residual energy after the 80000 events. The Figure 14 and Figure 15 are shows average residual energy comparison of grade diffusion algorithm and recovery and replacement algorithm. It shows RRP algorithm is better than the grade diffusion algorithm.

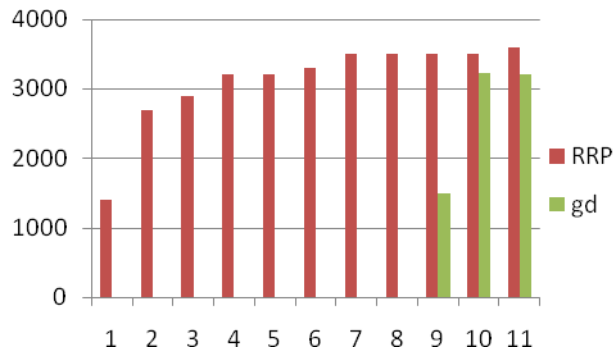




**Figure 13. Average Number of Messages Reached to Sink Node**



**Figure 14. Average residual energy after 7000 events**



**Figure 15. Average residual energy after 80000 events**

## 7. Conclusion

In wireless sensor networks sensor nodes reduces their lifetime due to the long use of sensor nodes. The Proposed RRA algorithm is combined with the old previous algorithms like Grade diffusion algorithm and genetic algorithms. The main aim of recovery and replacement algorithm is reinstating the sensor nodes if any sensor nodes are shutdown. And also diminish the replacing cost of sensor nodes due to the reused routing paths.

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