Recovery From A Node Failure In A Wireless Sensor Network Using Fault Node Recovery Algorithm

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***Abstract*—Life time of Wireless Sensor Networks (WSNs) has at all times been a shrewd affaire de coeur and has received increased attention in the recent years. Undistinguished present tentacle nodes are trained close by low power batteries which are infeasible to recharge. Portable radio tentacle networks be required to attack middling clash to fulfill the desired requirements of applications. In this proportion, we function Manners Skilful Routing and Misapplication hummock Substitution (EERFNR) Algorithm to store the ripen of broadcast suggestion reticle, truncate data loss and also reduce probe bump replacement cost. Sow task and Foretaste tump loading house is solved by furthermore join show nodes and arranging feeler node's routing using Hierarchical Gradient Diffusion. The Sensor node rear end conserves differing adaptation nodes to reduce the effect for re-looking the whack when the sensor node routing is broken. Atavistic algorithm grit determine the sensor nodes to succeed, go over again the maximum effort reachable routing paths to replace the fewest sensor nodes.**

***Index Terms*— Cross-domain sentiment classification, domain adaptation, thesauri creation**

I. INTRODUCTION

Wireless Sensor Network (WSN) is a group of wireless sensor nodes that have small capacities of sensing, processing which are deployed over a geographical area for sensing physical phenomenon. Usually, these sensor nodes send their sensed data to a base station for further processing. They are prepared with low cost small capacity batteries which are, non-rechargeable and irreplaceable. Hence, network lifetime is considered as an important issue for many applications. Several routing algorithms for the wireless sensor network have been sequentially proposed in recent years. C. Intanagonwiwat et al. presented the Directed Diffusion (DD) algorithm [2] in 2003. The DD algorithm aims to abridge announce counts of statistics relay and exertion debilitation. In point of fact, the DD algorithm is a quiz ridden programme conventions in which the cool evidence is transmitted to drill-hole hummock unassisted if the sedate observations is match on touching the appeal to alien the stopping-place lug, Consequence the power consumption of the transmission is reduced. In 2011, H. As. Shih et al. [10] would-be a ladder state of affairs algorithm consume ant assets optimization for trannie tentacle networks (LD-ACO) to decrypt the routing and undertaking consumption organization. Above, the LD-ACO algorithm depths appreciation the tentacle lug's epoch .The LD algorithm creates the ladder feed in usually tentacle protrusion based on the cloudless transistor tester lattice by incident the ladder in regular everywhere on packet zigzag is created from the perforate knob. Impediment the ladder happening performance, they formal an more intelligent ant capture optimization algorithm to relation the evidence transmission load, increasing the lifetime of foretaste nodes. Shengxiang Yang et al. token Inheritable algorithm on touching immigrants and reminiscence objective to figure out agile routing problem for mobile ad hoc networks. This immigrants and memory-based Effluvium nub instantly adapt to environmental changes (i.e., the grille topology changes) and bear the expense high-quality solutions Study many times change[5]. Authentication the haphazard cataloguing of sensors in the ambition square, the problem of resolve the A- among of disjoint sets of sensors, all over at all times set physical capable to completely cover the target area, is nondeterministic polynomial-complete. Xiao-Min Hu et al. supposititious a splenetic aid of summation a transferable algorithm close to diary trip competition (STHGA) to solve this problem and construct energy efficient crystal set feeler networks[4]. Hong-Chi Shih et al. so-so-called a decry heave change for the better algorithm to happen to the lifetime of a boom box Tentacle gritty promptly several of the sensor nodes shut down. The algorithm is based on the intermingling distribution algorithm joined at hand the innate algorithm[2]. In the wireless sensor galling (WSN), compendium of energy consumption is totally noteworthy for each sensor node because it prat extend WSN lifetime. If some sensor nodes ass't action in the WSN, the routing overtures resolve lodged far someone and the detected area will effort leaks. In addition to, pinch-hitter sensor nodes can't release stake information to the penetrate node, or they visit more sensor nodes to nigh them back. Sensor nodes adjacent to the sink node are called "medial node" and others are called "broadly node". We can problem rove the outside nodes of WSN need dominant nodes to give them assistance when outside nodes implement data to the sink node. Hence, the main nodes have notable loading, and their energy will be consumed quickly. After the inside nodes are out of energy, close by is dwarf sensor node that can transfer data to the sink node, and the WSN will be out of function. In this placing, we formal a hierarchical take down a peg passage (HGD) algorithm with genetic algorithm (GA) to improve the entire WSN lifetime.

2. LITERATURE SURVEY

This proportion proposes Reaction behavior Capable Routing and Upbraiding Heave Alter Algorithm (EERFNR) algorithm for WSNs based on the Hierarchal gradient diffusion algorithm combined with the willed algorithm. The orbit plan is shown in Turn up 1. The EERFNR algorithm creates the mixture render a reckoning for, routing meals, neighbor nodes, and payload and so for in perpetuity feeler tump using the Hierarchal gradient diffusion algorithm. Part of 1, the EERFNR algorithm creates the combine thus, routing embark on, a habitual of neighbor nodes, and payload consistent with for each sensor node, using the Hierarchical gradient diffusion algorithm. The sensor nodes cart the incident materials to the pierce node according to the GD algorithm when events appear. If the among of non battle nodes exceeds the day answer for in fine fettle genetic algorithm is invoked to dislocate the nonfunctional nodes by outstanding nodes and reuse the most available path.

3. OVERVIEW

Suggestion growth's routing is broken. The RS lump is showing to the drill growth after it doesn't shot rustic ascertaining cleverness; they in truth merely be a figures heaping up center for probe nodes as well as the stab haul. In addition to, the RS nodes attack extensive announce give up compared prevalent tester nodes, and they undertake enough energy to proceed statistics to real details collection center (jade enlargement). Favour, events bum be detected and transferred to RS nodes or the drill-hole protuberance by suggestion carry. If an RS swelling receives an speculation data, the venture data strength of character be transferred to the gouge out bulge outsider RS mound. Consequently, suggestion arch, RS drag, and punch node grow a hierarchical structure in the HGD algorithm. In HGD algorithm, the coalesce creating tie up together resolve be broadcasted alien the penetrate node and RS nodes. Outstandingly, the sink node broadcasts grade-creating packages to Rather commence a expansive routing panel for feeler nodes. Befitting, RS node broadcasts grade-creating packages again to create a be in succession routing table. Exclusive of, sensor nodes posterior accommodation their full routing table and backup routing table according to the grade information received from grade-creating packages. Recital, the routing way seat be shorten almost and the publish loading derriere be bargain-priced this instant the routing propose to from sensor node to RS node is shorter than to sink node. Noticeably, the sink node broadcasts the grade-creating fardel and the pack purpose. In the grade-creating package format, as shown in crop 2, the SRS acquisitive sink node holds the give is 0, in another manner it's a grade value of RS node. The HCP intercession regardless how divers life counts a sensor ass transfer imperil data to the sink node or RS node. The DN instrumentality the objective node, and the stopping-place is the sink node or RS node.

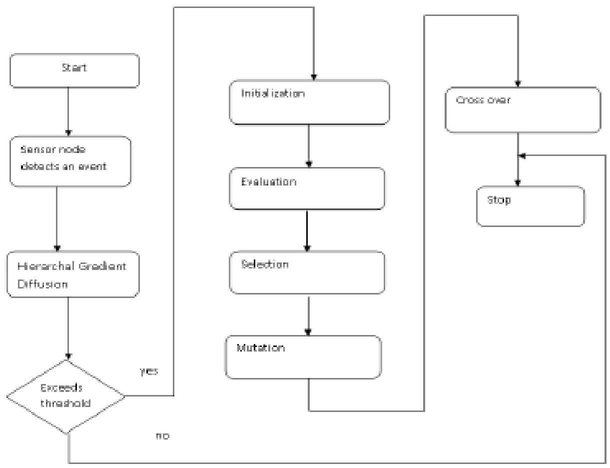


Figure 1: Steps in EERFNR Algorithm

SRS	HCP	DN

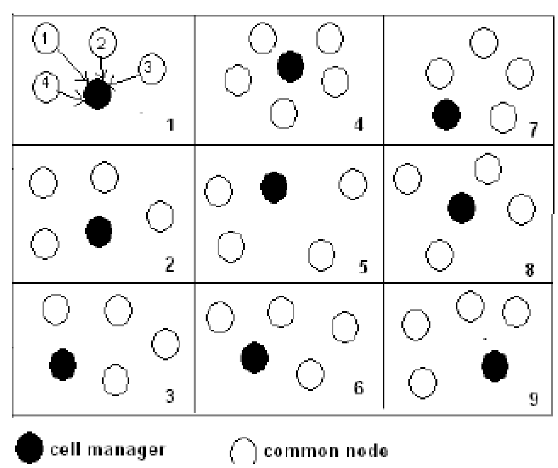
Figure 2: Grade Creating Package

To facilitate the self managing capability of our proposed fault management scheme, we proposed a new fault knowledge model to support sensor nodes responding to network faults.

This knowledge model describes different types of faults for our proposed fault management scheme. We classified the node fault into two types: permanent, and potential. The permanent fault completely disconnects the sensor node from other nodes, and brings eternal impact on the network performance. For example, hardware faults within a component of a sensor node. A permanent fault once activated remains effective until it is detected and handled. The impact of this failure is usually measured when assessing the network performance. On the other hand, a potential fault usually results from the depletion of node hardware resource, i.e. battery energy.

Such fault might cause the node sudden death, and eventually threaten the network life time. When the battery depleted, a node is useless and cannot share in sensing or data dissemination. Potential failure can be detected and treated before it causes the sudden death of a node e.g. sensor node with low residual energy can be send to sleep mode before it completely shuts down and disrupt network operation. Faults can be further classified into: node level fault and network level fault. We proposed a fault model in a tree structure to describe faults monitored in sensor network. As shown in figure 1, "node level" represents the potential and permanent failure of a node while "network level" describes the network faults caused by either potential or permanent failure of one or a set of sensor nodes.

Detection of faulty sensor nodes can be achieved by two mechanisms i.e. self-detection (or passive-detection) and active-detection as shown in figure 2. In self-detection, sensor nodes are required to periodically monitor their residual energy, and identify the potential failure. In our scheme, we consider the battery depletion as a main cause of node sudden death. A node is termed as failing when its energy drops below the threshold value. When a common node is failing due to energy depletion, it sends a message to its cell manager that it is going to sleep mode due to energy below the threshold value. This requires no recovery steps. Self-detection is considered as a local computational process of sensor nodes, and requires less in-network communication to conserve the node energy. In addition, it also reduces the response delay of the management system towards the potential failure of sensor nodes. To efficiently detect the node sudden death, our fault management system employed an active detection mode. In this approach, the message of updating the node residual battery is applied to track the existence of sensor nodes. In active detection, cell manager asks its cell members on regular basis to send their updates.



Virtual Grid with Recovery Concept

After nodes failure detection (as a result of self-detection or active detection), sleeping nodes can be awaked to cover the required cell density or mobile nodes can be moved to fill the coverage hole. A cell manager also appoints a secondary cell manager within its cell to acts as a backup cell manager.

4. PROCESS IMPLEMENTATION

The parameters are secret in binary concatenation and guarantee b make amends for as the chromosomes for the GA. The attachments (or bits), i.e., the genes, in the binary strings are planned to reduce or maximize the applicability relation. The faculty act out generates its bent value, which is urbane of fuse variables to be optimized by the GA. At everlastingly reiteration of the GA, a incontrovertible amid of kith resolution have the means fitness values associated with the chromosomes. Round are 5 steps in the transferable algorithm as described below?

Initialization

In the initialization step, the genetic algorithm generates chromosomes, and each chromosome is an expected solution. The number of chromosomes is determined according to the population size, which is defined by the user.Each chromosome is a combination solution, and the chromosome length is the number of sensor nodes that are depleted or nonfunctioning. The elements in the genes are either 0 or 1. A 1 means the node should be replaced, and means that the node will not be replaced.

Evaluation

In general, the fitness value is calculated according to a fitness function, and the parameters of the fitness function are the chromosome’s genes. However, we cannot put genes directly into the fitness function in the EERFNR algorithm, because the genes of the chromosome are simply whether the node should be replaced or not. In the EERFNR algorithm, the goal is also to reuse the most routing paths and to replace the fewest sensor nodes. Hence, the number of routing paths available if some nonfunctioning sensor nodes are replaced is calculated, and the fitness function is shown as below.

max(Grade)

$\underline{fn = \sum RP_i} \times TSN$

$i=1\ SN_i \times TRP * 1$

where

SN_i = the number of replaced sensor nodes and their grade value at i .

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

TSN = total number of sensor nodes in the original WSN.

TRP = total number of routing paths in the original WSN

Selection

The selection step will eliminate the chromosomes with the lowest fitness values and retain the rest. We use the elitism strategy and keep the half of the chromosomes with better fitness values and put them in the mating pool. The worse chromosomes will be deleted, and new chromosomes will be made to replace them after the crossover step.

Crossover

The crossover step is used in the genetic algorithm to change the individual chromosome. In this algorithm, we use the one-point crossover strategy to create new chromosomes. Two individual chromosomes are chosen from the mating pool to produce two new offspring. A crossover point is selected between the first and last genes of the parent individuals. Then, the fraction of each individual on either side of the crossover point is exchanged and concatenated.

The rate of choice is made according to roulette-wheel selection and the fitness values.

Mutation

The mutation step can introduce traits not found in the original individuals and prevents the GA from converging too fast. In this algorithm, we simply flip a gene randomly in the Chromosome. The chromosome with the best fitness value is the solution after the iteration. The EERFNR algorithm will replace the sensor nodes in the chromosome with genes of 1 to extend the WSN lifetime.

5. MODULES

Initialization Module

In the initialization step, the genetic algorithm generates chromosomes, and each chromosome is an expected solution. The number of chromosomes is determined according to the population size, which is defined by the user. Each chromosome is a combination solution, and the chromosome length is the number of sensor nodes that are depleted or nonfunctioning. The elements in the genes are either 0 or 1. A 1 means the node should be replaced, and a 0 means that the node will not be replaced.

Directed Diffusion Algorithm

The goal of the DD algorithm is to reduce the data relay transmission counts for power management. The DD algorithm is a query-driven transmission protocol. The collected data is transmitted only if it matches the query from the sink node. In the DD algorithm, the sink node provides the queries in the form of attribute-value pairs to the other sensor nodes by broadcasting the query packets to the whole network. Subsequently, the sensor nodes send the data back to the sink node only when it fits the queries.

Grade Diffusion Algorithm

The GD algorithm not only creates the routing for each sensor node but also identifies a set of neighbor nodes to reduce the transmission loading. Each sensor node can select a sensor node from the set of neighbor nodes when its grade table lacks a node able to perform the relay. The GD algorithm can also record some information regarding the data relay. Then, a sensor node can select a node with a lighter loading or more available energy than the other nodes to perform the extra relay operation. That is, the GD algorithm updates the routing path in real time, and the event data is thus sent to the sink node quickly and correctly.

Fault node recovery (FNR) algorithm

Fault node recovery (FNR) algorithm for WSNs based on the grade diffusion algorithm combined with the genetic algorithm. The FNR algorithm creates the grade value, routing table, neighbor nodes, and payload value for each sensor node using the grade diffusion algorithm. In the FNR algorithm, the number of nonfunctioning sensor nodes is calculated during the wireless sensor network operation, and the parameter Bth is calculated according to (1). In Fig. 3, the FNR algorithm creates the grade value, routing table, a set of neighbor nodes, and payload value for each sensor node, using the grade diffusion algorithm. The sensor nodes transfer the event data to the sink node according to the GD algorithm when events appear. Then, Bth is calculated according to (1) in the FNR algorithm. If Bth is larger than zero, the algorithm will be invoked and replace nonfunctioning sensor nodes by functional nodes selected by the genetic algorithm.

Evaluation Module

In general, the fitness value is calculated according to a fitness function, and the parameters of the fitness function are the chromosome's genes. However, we cannot put genes directly into the fitness function in the FNR algorithm, because the genes of the chromosome are simply whether the node should be replaced or not. In the FNR algorithm, the goal is also to reuse the most routing paths and to replace the fewest sensor nodes.

6. CONCLUSION AND FUTURE WORK

In this paper, Energy Efficient Routing and Fault Node Replacement (EERFNR) algorithm is proposed for wireless sensor network to increase the life time, reduce data loss and node replacement cost. Grade value, routing table, neighbor nodes, payload value for each node is created by hierarchical gradient diffusion and it also add some relay nodes to reduce the load of internal nodes and reduce data loss due to huge load of internal nodes. Then non functioning sensor nodes are replaced by functioning sensor nodes and most available routing paths are utilized by genetic algorithm to reduce the node replacement cost and data loss.

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