Reduction of energy consumption and Data loses in wsn's

Mr. K. E. Naresh Kumar [1], S. Sreenadh [2],

[1] M.Tech, Assistant professor of Rajeev Gandhi Memorial College of Engineering & Technology, Nandyal, Andhra Pradesh, India.

[2] MCA, Rajeev Gandhi Memorial College of Engineering & Technology, Nandyal, Andhra Pradesh, India.

***Abstract*—Life time of Wireless Sensor Networks (WSNs) has always been a critical issue and has received increased attention in the recent years. Generally wireless sensor nodes are equipped with low power batteries which are infeasible to recharge. Wireless sensor networks should have enough energy to fulfill the desired requirements of applications. In this paper, we propose Energy Efficient Routing and Fault node Replacement (EERFNR) Algorithm to increase the lifetime of wireless sensor network, reduce data loss and also reduce sensor node replacement cost. Transmission problem and sensor node loading problem is solved by adding several relay nodes and arranging sensor node's routing using Hierarchical Gradient Diffusion. The Sensor node can save some backup nodes to reduce the energy for re-looking the route when the sensor node routing is broken. Genetic algorithm will calculate the sensor nodes to replace, reuse the most available 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 reduce transmission counts of data relay and energy consumption. Basically, the DD algorithm is a query driven transmission protocol in which the collected data is transmitted to sink node only if the collected data is matched with the query from the destination node, hence the power consumption of the transmission is reduced. In 2011, H. C. Shih et al. [10] proposed a ladder diffusion algorithm using ant colony optimization for wireless sensor networks (LD-ACO) to solve the routing and energy consumption problem. Moreover, the LD-ACO algorithm can improve the sensor node's lifetime .The LD algorithm creates the ladder table in each sensor node based on the entire wireless sensor network by issuing the ladder in create packet that is created from the sink node. After the ladder diffusion process, they proposed an improved ant colony optimization algorithm to balancing the data transmission load, increasing the lifetime of sensor nodes. Shengxiang Yang et al. proposed Genetic algorithm with immigrants and memory scheme to solve dynamic routing problem for mobile ad hoc networks. This immigrants and memory-based GAs can quickly adapt to environmental changes (i.e., the network topology changes) and produce high-quality solutions after each change[5]. After the random deployment of sensors in the target area, the problem of finding the largest number of disjoint sets of sensors, with every set being able to completely cover the target area, is nondeterministic polynomial-complete. Xiao-Min Hu et al. proposed a hybrid approach of combining a genetic algorithm with schedule transition operations (STHGA) to solve this problem and construct energy efficient wireless sensor networks [4]. Hong-Chi Shih et al. proposed a fault node recovery algorithm to enhance the lifetime of a wireless sensor network when some of the sensor nodes shut down. The algorithm is based on the grade diffusion algorithm combined with the genetic algorithm [2]. In the wireless sensor network (WSN), reduction of energy consumption is very important for each sensor node because it can extend WSN lifetime. If some sensor nodes can't work in the WSN, the routing path will break and the detected area will have leaks. Moreover, other sensor nodes can't transfer event data to the sink node, or they need more sensor nodes to give them assistance. Sensor nodes near the sink node are called "inside node" and others are called "outside node". We can find that the outside nodes of WSN need inside nodes to give them assistance when outside nodes transfer data to the sink node. Hence, the inside nodes have huge loading, and their energy will be consumed quickly. After the inside nodes are out of energy, there is no sensor node that can transfer data to the sink node, and the WSN will be out of function. In this paper, we proposed a hierarchical gradient diffusion (HGD) algorithm with genetic algorithm (GA) to improve the entire WSN lifetime.

2. LITERATURE SURVEY

This paper proposes Energy Efficient Routing and Fault Node Replacement Algorithm (EERFNR) algorithm for WSNs based on the Hierarchal gradient diffusion algorithm combined with the genetic algorithm. The flow chart is shown in Figure 1. The EERFNR algorithm creates the grade value, routing table, neighbor nodes, and payload value for each sensor node using the Hierarchal gradient diffusion algorithm. Figure 1, the EERFNR algorithm creates the grade value, routing table, a set of neighbor nodes, and payload value for each sensor node, using the Hierarchical gradient diffusion algorithm. The sensor nodes transfer the event data to the sink node according to the GD algorithm when events appear. If the number of non functioning nodes exceeds the threshold value then genetic algorithm is invoked to replace the nonfunctional nodes by functional nodes and reuse the most available path.

3. OVERVIEW

Sensor node's routing is broken. The RS node is similar to the sink node because it doesn't have any detection ability; they can just be a data collection center for sensor nodes as well as the sink node. Moreover, the RS nodes have large transmission scale compared with sensor nodes, and they have enough energy to transfer data to real data collection center (Sink Node). Hence, events can be detected and transferred to RS nodes or the sink node by sensor node. If an RS node receives an event data, the event data will be transferred to the sink node from RS node. Hence, sensor node, RS node, and sink node become a hierarchical structure in the HGD algorithm. In HGD algorithm, the grade creating package will be broadcasted from the sink node and RS nodes. Firstly, the sink node broadcasts grade-creating packages to create a main routing table for sensor nodes. Then, RS node broadcasts grade-creating packages again to create a backup routing table. Moreover, sensor nodes can change their main routing table and backup routing table according to the grade information received from grade-creating packages. Thus, the routing path can be cut down and the transmission loading can be reduced when the routing path from sensor node to RS node is shorter than to sink node. Firstly, the sink node broadcasts the grade-creating package and the package format. In the grade-creating package format, as shown in figure 2, the SRS mean sink node holds the value is 0, otherwise it's a grade value of RS node. The HCP means how many hop counts a sensor can transfer event data to the sink node or RS node. The DN means the destination node, and the destination is the sink node or RS node.

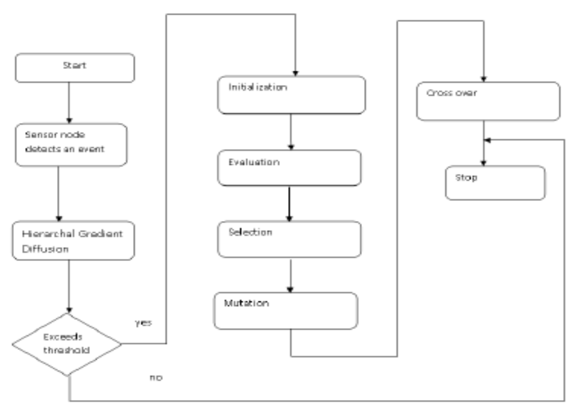


Figure 1: Steps in EERFNR Algorithm

SRS	HCP	DN

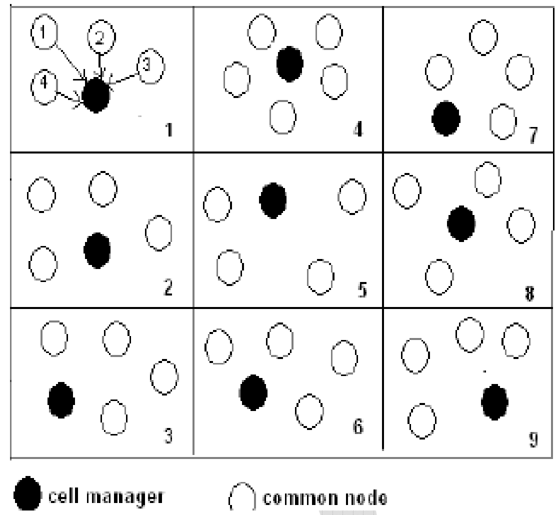
Figure 2: Grade Creating Package

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 encoded in binary string and serve as the chromosomes for the GA. The elements (or bits), i.e., the genes, in the binary strings are adjusted to minimize or maximize the fitness value. The fitness function generates its fitness value, which is composed of multiple variables to be optimized by the GA. At each iteration of the GA, a predetermined number of individuals will produce fitness values associated with the chromosomes. There are 5 steps in the genetic 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.

$$\max(Grade)$$

$$fn = \sum_{i=1} \frac{RP_i \times TSN}{SN_i \times TRP} * 1$$

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 *B*th 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, *B*th is calculated according to (1) in the FNR algorithm. If *B*th 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.

7. REFERENCES

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AUTHOR BIOGRAPHY

Author 1: Details

K E NareshKumar, received B.Tech degree in Computer Science and Engineering from Jawaharlal Nehru Technological University, Anantapur, India, in 2006. M.Tech in Computer Science from Visweswaraya Technological University, Belgaum, India.in 2010, working as an, Asst.Professor in CSE DeptatR.G.M.C.E.T, Nandyal, India.

Email: nareshforgovt@gmail.com

Author 2: Details

S. Sreenadh, received MCA degree from Jawaharlal Nehru Technological University, Anantapur,

Email: s.sreenadh123@gmail.com.