A FAULT NODE RECOVERY ALGORITHM TO REINFORCES THE LIFETIME AND ROUTING IN WIRELESS SENSOR NETWORK

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ABSTRACT

Wireless sensor networks have seen tremendous advances and utilization in the past two decades. Ranging from fossil oil exploration, mining, weather and even battle operations, all of those need detector applications. In the WSN, reduction of energy consumption is incredibly necessary for every each sensor node as a result of it will extend WSN period. The Wireless sensor network may be an assortment of sensors that are meet giant geographical region. Since sensors are wide unfold and enormous in range, the occurrences of faults within the network are additional. Therefore to detect the fault node and to replace the fault node an efficient algorithm is proposed. In this paper proposes a fault node recovery (FNR) to reinforce the period of a wireless sensor network (WSN) once a number of the sensor nodes stop working, either as a result of they now not have battery energy or they need reached their operational threshold. Using the FNR algorithm may end up in replacements of sensor nodes and more reused routing paths. Thus, the algorithm not solely enhances the WSN period however additionally reduces the cost of replacing the sensor nodes.

Keywords: Genetic Algorithm, Grade Diffusion (GD) Algorithm, Gradient Diffusion Algorithm, and Wireless Sensor Networks (WSN)

I. INTRODUCTION

RECENT advances in small process, wireless and battery technology and good sensors have enhanced information processing [5], wireless communication, and detection capability. In sensor networks, every sensor node has restricted wireless computational power to process and transfer the live data to the base station or data collection center. Therefore, to extend the sensor area and also the transmission area the wireless sensor network typically contains several sensor nodes. Generally, every sensor node features a low level of battery power that can't be replenished. Once the energy of a sensor node is exhausted, wireless sensor network leaks can seem, and also the unsuccessful nodes won't relay information to the opposite nodes throughout transmission process. Thus, the other sensor nodes are going to be burdened with exaggerated transmission process.

In the WSN, reduction of energy consumption is incredibly necessary for every each sensor node as a result of it will extend WSN period. The Wireless sensor network may be an assortment of sensors that are meet giant geographical region. Since sensors are wide unfold and enormous in range, the occurrences of faults within the network are additional. Therefore to detect the fault node and to replace the fault node an efficient algorithm is proposed. This work proposes a fault node recovery (FNR) to reinforce the period of a wireless sensor network (WSN) once a number of the sensor nodes stop working, either as a result of they now not have battery energy or they need reached their operational threshold. Using the FNR algorithm may end up in replacements of sensor nodes and more reused routing paths. Thus, the algorithm not solely enhances the WSN period however additionally reduces the cost of replacing the sensor nodes.

1.1 Wireless Sensor Networks

Wireless sensor networks have seen tremendous advances and utilization in the past two decades. Ranging from fossil oil exploration, mining, weather and even battle operations, all of those need detector applications. One reason behind the growing quality of wireless sensors is that they'll add remote areas while not manual intervention. All the user needs to do is to collect the data sent by the sensors, and with bound analysis extract important information from them. Typically sensor applications involve several sensors deployed along. These sensors form a network and collaborate with one another to collect data and send it to the base station. These nodes combine with routers and gateways to form a WSN system. The WSN is formed of nodes from a couple of too many hundred, wherever every node is connected to at least one or many sensors as shown in figure 1.

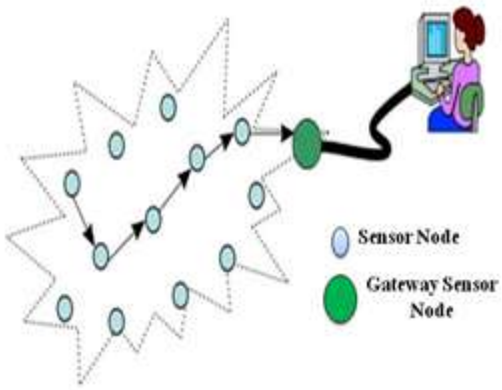

Fig. 1: Typical Multi-Hop Wireless Sensor Network Architecture

II. RELATED WORK

Failures are unavoidable in Wireless Sensor Networks due to the lack of observation and unattended deployment. There is a unit several problems associated with energy, memory and process ability of a sensor node. The occurrences of faults are a unit largely due the presence of faulty sensor nodes [1]. To identify a fault node and to interchange it, several techniques are proposed.

C. Intanagonwiwat et al. [1] explored the directed-diffusion paradigm for such coordination. Directed diffusion is data-centric there in all communication is for named data. All nodes in an exceedingly directed-diffusion-based network are a unit application aware. This permits diffusion to realize energy savings by choosing through empirical observation smart ways and by caching and process knowledge in-network (e.g., data aggregation). They explore and evaluated the employment of directed diffusion for a straightforward remote-surveillance device network analytically and by experimentation.

Fault management for WSNs [2] is totally different from traditional networks. Recent analysis has developed many schemes and techniques that affect differing kinds of faults at totally different layers of the network. All these techniques consider only few issues of WSNs. An efficient Fault Management system or model should take into account most problems or forms of faults.

J. A. Carballido et al. [3] mentioned the foundations and implementation of a genetic algorithm (GA) for instrumentation functions. The GA constitutes a format module of a call network for sensor network style. The tactic development entailed the definition of the individual's illustration additionally because the design of a graph-based fitness operates, alongside the formulation of many alternative impromptu enforced options. The performance and effectiveness of the GA were assessed by initializing the instrumentation design of an ammonia synthesis plant. The format provided by the GA succeeded in fast the sensor network design procedures. It conjointly accomplished a great improvement within the overall quality of the ensuing instrument configuration. The GA will constitute a valuable tool for the treatment of real industrial issues.

H. C. Shih et al. had given the Grade Diffusion (GD) [4] algorithm in 2012 to enhance the ladder diffusion algorithm using ant colony optimization (LD-ACO) for wireless sensor networks. The GD algorithm not solely creates the routing for every sensor node however additionally identifies a collection of neighbor nodes to scale back the transmission loading. Every sensor node can choose a sensor node from the set of neighbor nodes once its grade table lacks a node able to perform the relay.

Hong-Chi Shih et al. proposed a fault node recovery (FNR) algorithm[6] to boost the life of a wireless sensor network (WSN) once a number of the sensor nodes pack up, either as a result of they not have battery energy or they need reached their operational threshold. Mistreatment the FNR algorithmic rule may end up in fewer replacements of device nodes and additional reused routing paths. Thus, the algorithm not solely enhances the WSN lifespan but also reduces the cost of exchange the sensor nodes. The normal approaches to sensor network routing embrace the directed diffusion (DD) [1] algorithm and the grade diffusion (GD) algorithm [4]. The algorithm proposed in this paper relies on the GD algorithm, with the goal of exchange fewer sensor nodes that are a unit inoperative or have depleted batteries, and of reusing the most variety of routing paths. These optimizations can ultimately enhance the WSN lifespan and reduce sensor node replacement cost.

III. EXISTING SYSTEM

3.1 Directed Diffusion Algorithm

A series of routing algorithms for wireless sensor networks have been proposed in recent years. C. Intanagonwiwat et al. given the Directed Diffusion (DD) algorithm [1] in 2003. The goal of the DD algorithm is to scale back the data relay transmission counts for power management. The DD algorithm may be a query-driven transmission protocol. The collected data is transmitted providing it matches the query from the sink node. Within the DD algorithm, the sink node provides the queries within the type of attribute-value pairs to the opposite sensor nodes by broadcasting the query packets to the total network. After, the sensor nodes send the data back to the sink node only when it fits the queries.

3.2 Grade Diffusion Algorithm

H. C. Shih et al. had given the Grade Diffusion (GD) [4] algorithm in 2012 to enhance the ladder diffusion algorithm using ant colony optimization (LD-ACO) for wireless sensor networks. The GD algorithm not solely creates the routing for every sensor node however additionally identifies a collection of neighbor nodes to scale back the transmission loading. Every sensor node can choose a sensor node from the set of neighbor nodes once its grade table lacks a node able to perform the relay.

The GD algorithm may also record some information relating to the data relay. Then, a sensor node will choose a node with a lighter loading or a lot of offered energy than the opposite nodes to perform the additional relay operation. That is, the GD formula updates the routing path in real time, and also the event data is so sent to the sink node quickly and properly and shown in Figure 3.

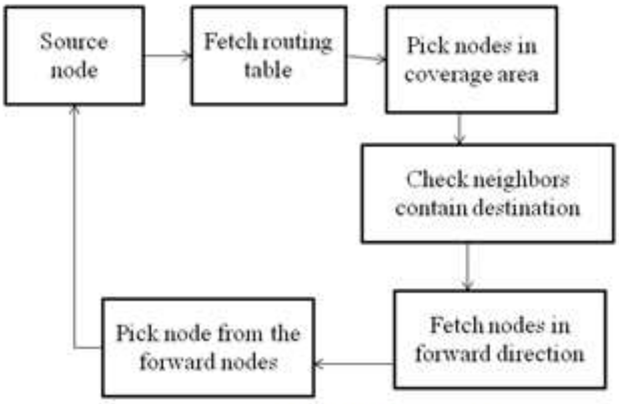

Fig. 3: Grade Diffusion Flowchart

Whether the DD or the GD algorithmic rule is applied, the grade making packages or interested query packets should first be broadcast. Then, the sensing element nodes transfer the event data to the sink node, in step with the algorithmic rule, once appropriate events occur. The sensor routing paths are shown in Figure 4.

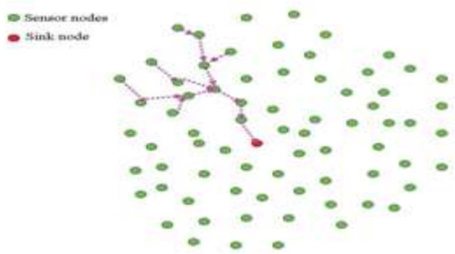

Fig. 4: Wireless Sensor Node Routing.

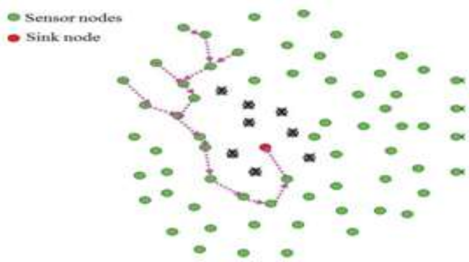

Fig. 5: Wireless Sensor Node Routing Path When Some Nodes Are Not Working.

The WSN could fail due to a spread of causes, together with the following: the routing path would possibly expertise a break; the WSN sensing space would possibly expertise a leak; the batteries of some sensor nodes could be depleted, requiring additional relay nodes; or the nodes wear out when the WSN has been in use an extended amount of your time. In Figure 5, the situation in which the outside nodes transfer event data to the sink node via the inside nodes (the sensor nodes near the sink node) in a WSN illustrate the accommodation measures for non-working nodes. The inside nodes therefore have most important data transmission loading, intense energy at a quicker rate. If all the inside nodes spend their energy or otherwise stop to operate, the event data will now not be sent to the sink node, and therefore the WSN can now not operate.

The power consumption of the sensor nodes in WSNs is inevitable. However, proposes an algorithm to search for and replace fewer sensor nodes and to utilize the foremost routing ways. Typical search techniques are often incapable of optimizing nonlinear functions with multiple variables. One scheme, the genetic algorithm (GA), may be a directed random search technique developed in 1975, supported the conception of natural biology. The present work proposes a fault node recovery (FNR) algorithmic rule supported the GD algorithm combined with the GA. The FNR algorithm creates a routing table using the GD algorithm and replaces sensor nodes using the GA once the amount of sensor nodes that are not functioning exceeds the brink. This algorithmic rule not solely reuses the foremost routing ways to reinforce the WSN life however additionally reduces the cost.

IV. PROPOSED SYSTEM

This work proposes a fault node recovery (FNR) [6] algorithm to boost the period of time of a wireless sensor network (WSN) once a number of the sensor nodes pack up, either as a result of they not have battery energy or they need reached their operational threshold. Victimization the FNR algorithm may end up in fewer replacements of sensor nodes and additional reused routing paths. Thus, the rule not solely enhances the WSN period of time however additionally reduces the value of replacement the sensor nodes. The standard approaches to sensor network routing embrace the directed diffusion (DD) [1] algorithm and also the grade diffusion (GD) [4] algorithm. The rule projected during this work relies on the GD algorithm, with the goal of replacement fewer sensor nodes that square measure inoperative or have depleted batteries, and of reusing the utmost variety of routing paths. These optimizations can ultimately enhance the WSN lifetime and reduce sensor node replacement cost.

This work proposes a fault node recovery (FNR) algorithm for WSNs supported the grade diffusion algorithm [6] combined with the genetic rule. The Block diagram and flow chart is shown in Figure 6. The FNR algorithm creates the routing table, grade value, neighbor nodes, and payload value for every sensor node using the grade diffusion algorithm. In the FNR algorithm, the amount of nonfunctioning sensor nodes is calculated throughout the wireless sensor network operation, and also the parameter B^{th} is calculated consistent with (1).

In Figure 6, the FNR algorithm creates the grade value, routing table, a group of neighbor nodes, and payload value for every sensor node, victimization the grade diffusion rule. The sensor nodes transfer the event data to the sink node consistent with the GD rule once events seem. Then, B^{th} is calculated consistent with (1) within the FNR algorithm [2]. If B^{th} is larger than zero, the rules are going to be invoked and replace nonfunctioning device nodes by purposeful nodes selected by the genetic rule. Then the wireless device network will still work as long because the operators square measure willing to switch sensors

In (1), Grade is the sensor node's grade value. The variable $N_i^{original}$ is the number of sensor nodes with the grade value i. The variable N_i^{now} is the number of sensor nodes still functioning at the current time with grade value i. The parameter β is about by the user and should have a worth between 0 and 1. If the amount of sensor nodes that operate for every grade is a smaller amount than β, Ti can become 1, and B^{th} are going to be larger than zero. Then, the algorithm can calculate the sensor nodes to replace using the genetic algorithm. The parameters square measure encoded in binary string and function the chromosomes for the GA. The elements (or bits), i.e., the genes, within the binary strings square measure adjusted to reduce or maximize the fitness value. The fitness operate generates its fitness value that consists of multiple variables to be optimized by the GA. Within every, iterations of the GA a pre-determined number of individuals will produce fitness values related to the chromosomes. There are five steps within the genetic algorithm: Initialization of data format, Evaluation, Selection, Crossover, and Mutation of corresponding data.

In initialization chromosome are generated. Every Chromosome is associate degree expected. The quantity of chromosomes depends on number of sensors to be replaced. Next is the evaluation method the quantity of routing path on the market if some non functioning sensors square measure replaced is evaluated supported fitness value. This fitness value is calculated with variety of sensor nodes grade values, number of reusable routing methods, total number of sensor nodes in original WSN, and total number of routing methods in original WSN. And in selection step chromosomes with lowest fitness values are eliminated. Two individual chromosomes are chosen and compared and a part of it is replaced with the other to produce new offspring are obtained by crossover process. At last a single gene is replaced after comparison happened in mutation process.

$$B^{th} = \sum_{i=1}^{\max\{Grade\}} T_i$$

$$T_i = \begin{cases} 1, & \frac{N_i^{now}}{N_i^{original}} < \beta \\ 0, & otherwise \end{cases} \quad (1)$$

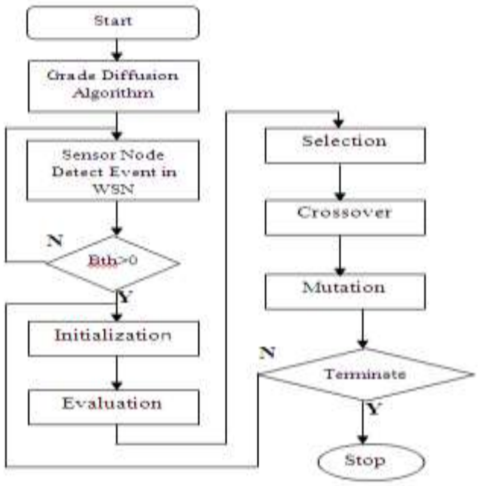

Fig. 6: Fault Node Recovery Algorithm Flow Chart

V. CONCLUSION

In real wireless sensor networks, the sensor nodes use battery power provides and so have restricted energy resources. Additionally to the routing, it's vital to analysis the improvement of sensor node replacement, reducing the replacement cost, and reducing the cost, and reusing the foremost routing ways once some sensor nodes are a unit nonfunctional. This work proposes a fault node recovery algorithm for WSN supported the grade diffusion algorithm combined with a genetic algorithm. The FNR algorithm needs replacement fewer sensor nodes and reuses the foremost routing paths, increasing the WSN lifespan and reducing the cost.

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