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Fault Node Prediction Model in Wireless Sensor Networks Using Improved Generic Algorithm

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***Abstract*. This paper proposes a fault node Recovery algorithm to improve routing efficiency in wireless sensor networks. A node can be faulty when some of the sensor nodes shut down, either because they no longer have battery energy or they have reached their operational threshold. The proposed Faulty node recovery algorithm can result in fewer replacements of sensor nodes and more reused routing paths. Thus, the algorithm not only enhances the Wireless sensor network lifetime but also reduces the cost of replacing the sensor nodes.**

***Keywords*-Fault node detection, Genetic algorithm, Grade diffusion (GD) algorithm, Directed Diffusion Algorithm**

I. INTRODUCTION

Wireless Sensor Network (WSN) is a type of network which is a collection of tiny device called sensors nodes. In real wireless sensor networks, we have lim- ited energy resources because the sensor nodes use battery power supplies. Recent advances in wireless, battery technology, micro processing, and smart sen- sors have enhanced data processing wireless commu- nication, and detection capability. To process and transfer the live data to the base station or data collec- tion center ,in sensor networks, each sensor node has limited wireless computational capability. Therefore, to improve the sensor area and the transmission area the wireless sensor network usually contains many sensor nodes. Normally, each sensor node has a lim- ited level of battery power that cannot be recharged.

The wireless Sensor network tweaks will arise, when the energy of a sensor node is exhausted, and the failed nodes will not relay data to the other nodes during transmission processing. Thus, with the in-creased transmission processing other sensor nodes will be burdened.

The main features of WSNs, as could be deduced by the general description are: scalability with respect to the number of nodes in the network, self- recovering, self-organization, energy efficiency, a sufficient de-gree of connectivity between nodes, low complexity, lowest cost and size of nodes. This kind of protocol architectures and technical solutions offering such features can be considered as a potential framework for the creation of these networks, but, unfortunately, the definition of such a protocol architecture and technical solution is not simple, and the research still needs to work on it.

The massive research on WSNs started after the year 2000. However, it took advantage of the outcome of the research on wireless networks performed since the second half of the previous century. In particular, the study of ad hoc networks attracted a lot of atten-tion for several decades, and some researchers tried to report their skills acquired in the field of ad hoc networks, to the study of WSNs.

In sensor networks, each sensor node has limited wireless computational power to process and transfer the live data to the base station or data collection center [2], [5]. Therefore, to increase the sensor area and the transmission area [1] the wireless sensor network usually contains many sensor nodes. Generally, each sensor node has a low level of battery power that cannot be replenished. When the energy of a sensor node is discharged, wireless sensor network tweaks will appear, and those failure nodes will not be able to relay data to the other nodes during transmission processing. Thus, the other sensor nodes will be bur-dened with increased transmission of data. The use of WSN networks also leads additional security chal-lenges that have to be dealt with.

This paper proposes a fault node Recovery algorithm to improve routing efficiency in wireless sensor net-works. A node can be faulty when some of the sensor nodes exhausted, either because they no longer have battery power or they have reached their operational threshold. The algorithm Faulty node recovery can result in fewer replacements of sensor nodes and more reused routing paths. By this the algorithm not only improves the Wireless sensor network lifetime but also reduces the cost of replacing the sensor nodes.

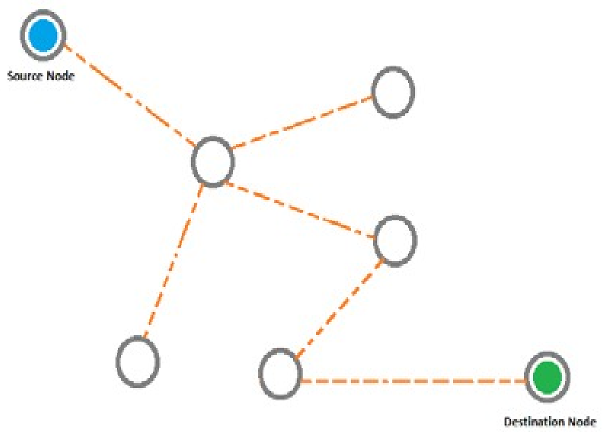

Figure 1: Wireless Sensor Network Routing

II. RELATED WORK

Many techniques have been proposed till now for faulty node detection and recovering such nodes. Sony Jia et al. [1] proposed recovery Algorithm based on Minimum Distance Redundant Nodes. This process of examining redundant nodes is defined in the recovery algorithm and is deployed on the sink node with unconstrained energy consumption which Traces the location of all active nodes and redundant nodes in the Wireless sensor network. Simulation results in demonstrating that, by choosing appropriate number of redundant nodes, proposed algorithm has shown great coverage quality and recovery accuracy, and also justify the purpose of prolonging the lifecy-cle of Wireless sensor network.

Muhammed Asim et al. [8] continued the cellular approach and proposed a new fault management mechanism to deal with fault detection and recovery of Wireless Sensor Networks. They proposed a new model which is hierarchical for properly distributing fault management tasks among sensor nodes by in- troducing more "self-managing" functions. The new- ly proposed failure recovery algorithm has been compared with some existing related work and prov-en to be more energy efficient.

III. PROPOSED WORK

Sensor network routing includes the directed diffu- sion algorithm and grade diffusion algorithm. Grade diffusion and ACO is proposed to solve the power consumption and transmission routing problems in wireless sensor networks. The proposed grade diffu- sion algorithm is subjected to route paths for data relay and transmission in wireless sensor networks, minimizing both power consumption as well as pro- cessing time to build the routing table and simultane- ously avoiding the generations of circle routes.

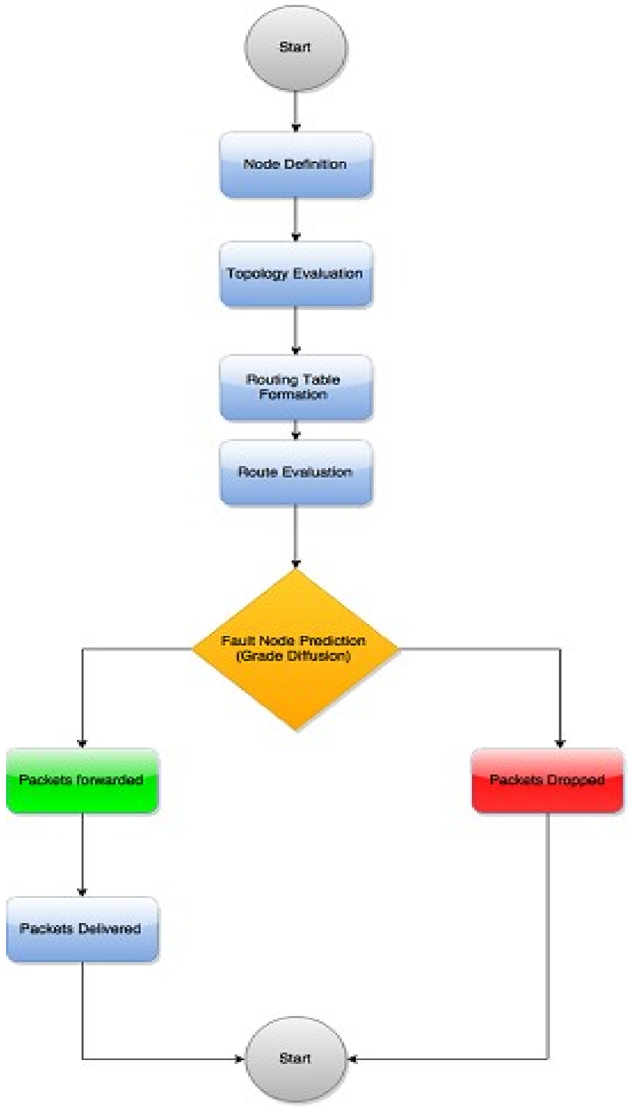

Figure 2: Fault Node Recovery - Flow

A. Directed Diffusion Algorithm

The DD algorithm is a query-driven model protocol. The collected data will be transmitted only when it matches the query from the specified sink node. Moreover in this algorithm, the sink node will pro- vide the queries in the form of attribute-value pairs to the other sensor nodes by broadcasting the query packets to the entire network. Finally, the sensor nodes send the data back to the sink node only when it fits the queries.

B. Grade Diffusion Algorithm

H. C. Shih *et al.* presented the Grade Diffusion (GD) algorithm in 2012 to improve the ladder diffusion algorithm using ant colony optimization (LD-ACO)for wireless sensor networks. To reduce the loaded transmission, the GD algorithm creates the routing for each sensor node and also identifies a set of neighbor nodes. Each sensor node can select a sensor node from the set of neighbor nodes when its grade table lacks a node which is able to perform the relay. To track the information related to the data relay, we use GD algorithm . 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 operations. It means the GD algorithm can update the routing path in real time, and the generated event data will be sent to the sink node accurately and quickly. The query packets that are interest showing or grade creating packages must first be broadcast when we apply GD or DD algorithm. When events are suitable then, as per the algorithm the sensor nodes transfer the event data to the sink node.

Grade diffusion algorithm is proposed to solve the sensor node's transmission problem and the sensor node's loading problem in wireless sensor networks by to arrange the sensor node's routing. Additional to them, the sensor node can also save some backup nodes to reduce the energy consumption for the re-looking routing by our proposed algorithm routing is broken in sensor node's. In simulation, for sensor node the grade diffusion algorithm can save 29.5% energy and increase 80.39% time than the tradition algorithms.

IV. EXPERIMENTAL RESULTS

After the simulation, the proposed algorithm had only suffered 4.95% of data losses, but the DD and GD algorithm had suffered almost 45% and 44% data losses respectively. This new algorithm can reduce data loss almost by 98.5% compared to the traditional algorithms. Fig.3 compares the average energy con- sumption of a WSN managed using the FNR algo- rithm to the average energy consumption using the DD and GD algorithms. The DD and GD algorithms allows WSN to consume more energy after 10000 events because the inside nodes are energy- diminished, but the outside nodes continue to attempt to transfer event data to the sink node through the inside nodes until they are also energy diminished. After finishing 90000 events, the GD and DD algo- rithm-managed WSN had consumed 3295.33 WS and 3291.39 WS respectively.

It is observed that the proposed recovery algorithm increases the WSN lifetime by replacing some of the sensor nodes that are not functioning. Additional to enhancing the active nodes and reducing the data losses, the FNR algorithm reduced the relayed energy usage by reducing the number of data relayed, as the replaced sensor nodes are usually used the most. After the above evaluated events, using the proposed algorithm, the WSN had consumed only 2207.38 Ws, and, compared to using the DD and GD algorithms, exhibited a reduction in energy consumption of 31.1% and 27%, respectively. After that, we experi-ment different node densities in our simulation.

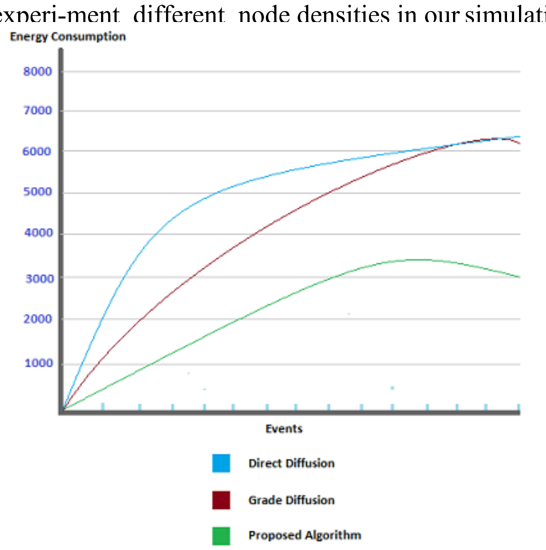

Figure 3: Energy Consumption - Comparison

Hence, the FNR algorithm has the best energy-saving performance no matter under any node densities. The average number of messages that reach the sink node when each algorithm manages the network is com-pared in Fig.3. Using the traditional DD and GD al-gorithms, the sink node can receive no messages after 8000 events because all of the inside nodes are ener-gy-diminished, and the WSN lifetime is exhausted. This proposed algorithm replaces energy-diminished sensor nodes to increase the WSN lifespan. So, the average number of messages received using this algo-rithm is higher than when using the other algorithms.

V. CONCLUSION

In this paper, the proposed algorithm will require a minimal number of communications across the net- work and provides modifiable parameters to maximize performance for various wireless network topologies. This paper provides a powerful technique for defining algorithm the fits various topologies and data clustering. For topologies with highly variant clusters of wireless sensor node, it goes increasingly difficult to accurately limit random sample due to the common inability of random walk process to quickly reach all clusters. The experimental results proposed above tells the current fault node recovery algorithm may be enhanced further to find the exact faulty node, which at the present may be difficult. This is because of the use of unstructured wireless sensor network, and nodes that are frequently joining or leaving the network without past data. The Faulty node recovery algorithm model used in minimize this cost, which is one of the major outcomes compared to accuracy.

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