Recovering Multiple Failure Nodes in Wireless Sensor-Actor Networks with Least Distance Movements

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Abstract: ***Wireless device and actor networks (WSANs) are a bunch of sensors and actors joined by wireless medium to perform distributed sensing and exploit tasks. In such a network, sensors gather info concerning the physical world, whereas actors take choices and so perform acceptable actions upon the surroundings, that permits remote, machine-controlled interaction with the surroundings. Actors sometimes coordinate their motion in order that they keep approachable to every different sensors. However, a failure of associate actor might cause the network to partition into disjoint blocks and would therefore violate such a property demand. In this project, we tend to present a new algorithmic rule which is localized and distributed algorithmic that leverages existing route discovery activities within the network and imposes no extra pre-failure communication overhead.***

Keywords: Multiple node failure, WSAN, Pre-failure, Overhead Management, Actor Movement.

1. Introduction

Recent years Wireless sensing element and Actor Networks square measure gaining growing interest due to their suitableness for mission vital applications that need autonomous and intelligent interaction with the settings. Samples of these applications embody fire observance, disaster management, search and rescue, security police investigation, field intelligence operation, coast and border protection, etc. WSANs comprise varied miniaturized stationary sensors and fewer mobile actors[1]. The sensors function wireless knowledge acquisition devices for the additional powerful actor nodes that method the sensing element readings and proposes associate applicable varied miniaturized stationary sensors and fewer mobile actors.

The sensors function wireless knowledge acquisition devices for the additional powerful actor nodes that method the sensing element readings associated proposes an applicable response.

For example, sensors could find a hearth associated trigger a response from associate actor that has a device. Robots and pilotless vehicles are a unit example actors in observe[2]. Actors work autonomously and collaboratively to attain the appliance mission. Given the cooperative actors operation, a powerfully connected inter-actor configuration would be needed in any respect times. Failure of 1 or multiple nodes could partition the inter-actor network into disjoint segments. Consequently, associate inter-actor interaction could stop and therefore the network becomes incapable of delivering a timely response to a significant event. Therefore, recovery from associate actor failure is of utmost importance.

The remote setup during which WSANs usually serve makes the readying of extra resources to switch failing actors impractical, and emplacement of nodes becomes the simplest recovery possibility[3]. Distributed recovery is going to be terribly difficult since nodes in separate partitions won't be ready to reach one another to coordinate the recovery method. Therefore, up to date schemes found within the literature re-quire each node to take care of partial data of the network state. To avoid the excessive state-update overhead and to expedite the property restoration method, previous work depends on maintaining one- or two-hop neighbor lists and predetermines some criteria for the node's involvement within the recovery[4]-[6].

In contrast to previous work, this paper considers the property restoration downside subject to path length constraints. In some applications, timely coordination among the actors is needed, and lengthening the shortest path between 2 actors as a aspect result of the recovery method wouldn't be acceptable.

Most of the prevailing approaches within the literature are strictly reactive with the recovery method initiated once the failure of “F” is detected[7]. the most plan is replace the unsuccessful node “F” with one in every of its neighbors or move those neighbors inward to autonomously mend cut topology within the neighbourhood of F[8],[9].

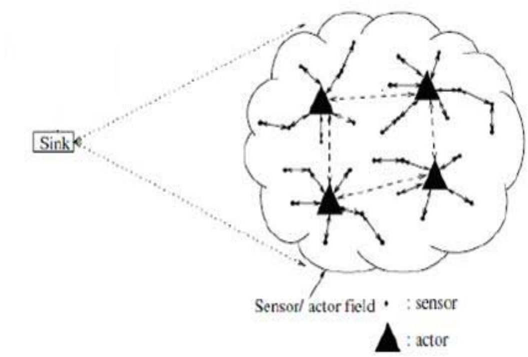

Figure 1: An Example wireless sensor and actor network setup

2. Literature Survey

A number of schemes have recently been planned for restoring network property in divided WSANs [10]. All of those schemes have centered on reestablishing cut off links while not considering the impact on the length of pre-failure information methods. Some schemes recover the network by placement the prevailing nodes, whereas others rigorously place extra relay nodes. Like our planned DCR algorithmic program, DARA [11] strives to revive property lost as a result of failure of cut-vertex. However, DARA needs additional network state in order to make sure convergence. Meanwhile, in PADRA [12], determine a connected dominating set (CDS) of the full network so as to discover cut-vertices. Although, they use a distributed algorithmic program, their resolution still needs 2-hop neighbor's data that will increase electronic communication overhead.

Another work planned in [13] conjointly uses 2-hop data to discover cut-vertices. The planned DCR algorithmic program depends solely on 1-hop data and reduces the communication overhead. Though RIM [14], C3R [15] and tape machine [16] use 1- hop neighbor data to revive property, they are strictly reactive and don't differentiate between crucial and non-critical nodes. Whereas, DCR could be a hybrid algorithmic program that proactively identifies crucial nodes and designates for them applicable backups. the prevailing work on synchronic node failure recovery planned in could be a mutual exclusion mechanism known as [17] so as to handle multiple synchronic failures in a very localized manner.

Our planned approach differs from MPADRA in multiple aspects. Whereas, our approach solely needs 1-hop data and every crucial node has just one backup to handle its failure.

3. System Model and Problem Statement

For restoring network property in partitioned off WSANs variety of schemes has recently been projected. All of those schemes have targeted on reestablishing cut links while not considering the impact on the length of pre-failure knowledge ways. Some schemes recover the network by positioning the prevailing nodes, whereas others fastidiously place further relay nodes. On the opposite hand, some work on device relocation focuses on metrics aside from property, e.g., coverage, network longevity, and quality safety, or to self-spread the nodes once non-uniform readying.

Existing recovery schemes either impose high node relocation overhead or extend a number of the inter-actor knowledge ways. Existing recovery schemes targeted on reestablishing cut links while not considering the impact on the length of pre-failure knowledge ways.

4. Proposed system

In this project, we proposed a new routing method based on extra actor (Enhanced Least Disruptive topology Repair). Here the extra actor node will acts as a centralized node, which will control the node movements. Our method main aim is to overcome the multi-node failures. The performance of LeDiR is simulated on NS2 tool.

Advantages:

- It is nearly insensitive to the variation within the communication vary.
- Number of nodes participating will be less in count.
- Network performance will be improved.

5. Implementation

1. Failure Detection

Actors can sporadically send heartbeat messages to their neighbours to make sure that they're useful, and conjointly report changes to the one-hop neighbours. Missing heartbeat messages will be accustomed observe the failure of actors. After that it’s simply check whether or not failing node is vital node or not. Critical node suggests that if that node failing it type disjoint block within the network.

2. Smallest block identification

In this step we've to seek out smallest disjoint block. If it's tiny then it'll scale back the recovery overhead within the network.

- The tiniest block is that the one with the smallest amount variety of nodes.
- By finding the accessible set of nodes for each direct neighbour of the failing node then selecting the set with the fewest nodes.

3. Substitution of faulty node

Here we have to substitute the faulty node by extra actor and we have to restore the network quickly. When the node failure is detected by heart beat message then extra actor node will moves to that particular location and it will take care of the restoration, i.e., it will control the actor movements. It will find which nodes are affected by the failure and inform to that nodes to which position they have to move. After restoration the extra actor will go back to its original position.

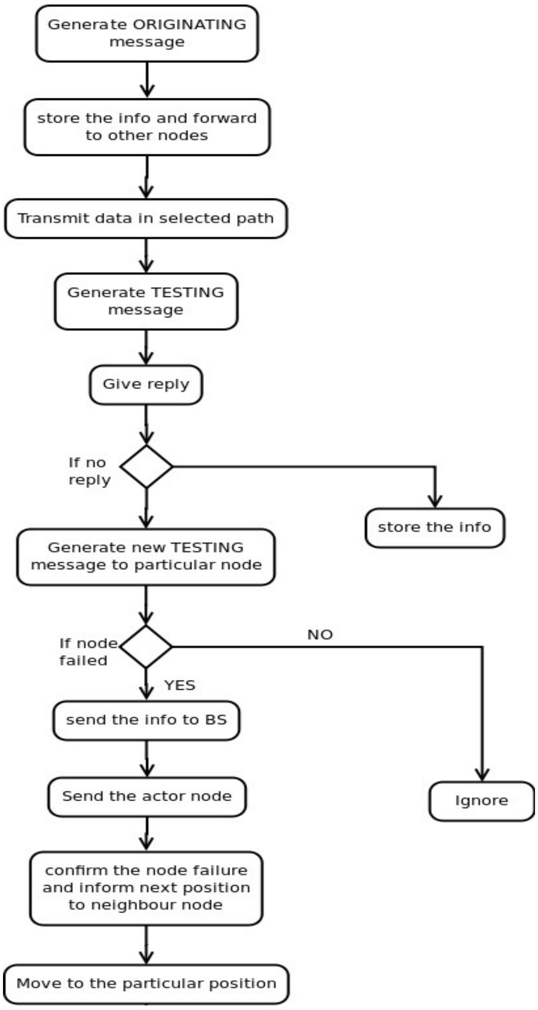

Figure 2: Implementation Flow Chart

Results

Here we analyzed the system performance based on Delay, nodes involved in restoration, PDF and Over Head which are explained below. The below graph represents the comparison of delay in the network of the existing and proposed method. Here X-axis represents the protocol and Y-axis represents the delay in seconds. In our proposed method we have 0.2s delay where as in existing method we have 1.5s delay.

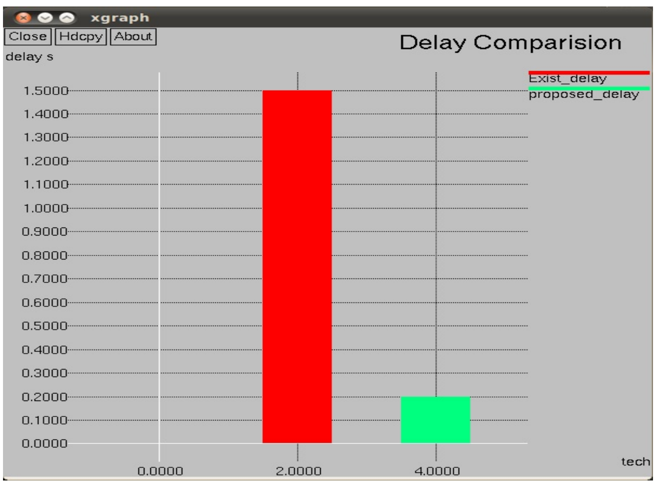

Figure 3: Delay Comparison between LeDiR & ELeDiR

The below figure represents number of nodes involved in the restoration of the network. Here X-axis represents protocol and Y-axis represents number of nodes. Here we can observe that in LeDiR six nodes involved in restoration which will creates more disturbances in the network but in our method only three nodes involved in the restoration.

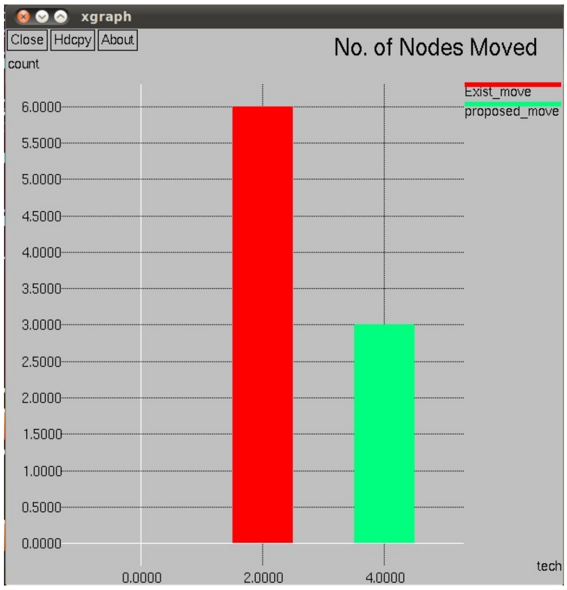

Figure 4: No. of nodes moved in LeDiR & ELeDiR

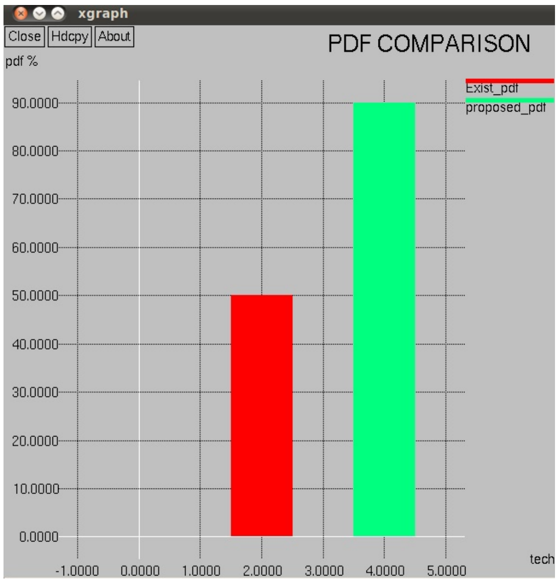

Figure 5: PDF Comparison between LeDiR & ELeDiR

The above figure represents packet delivery ratio of the network. In this X-axis represents protocol and Y-axis represents percentage of packets delivered. In multi node failure case LeDir shown 50% packet delivery but ELeDir method shown 90% packet delivery. The below figure represents Over Head of the network in LeDiR and ELeDiR. In this X-axis represents protocol and Y-axis represents the number of over head packets size. Compared to LeDiR the ELeDiR contains less Over Head.

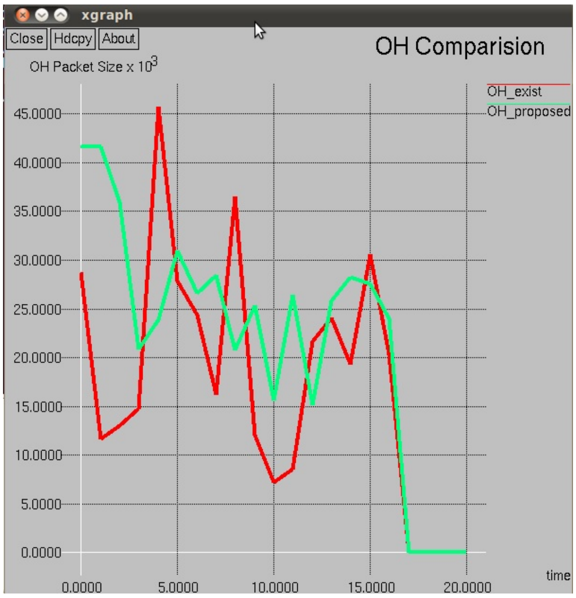

Figure 6: OH Comparison between LeDiR & ELeDiR

6. Conclusion

Inter-actor network connectivity is essential in most of the WSAN applications to perform collaborative actions in an efficient manner. Therefore, maintaining connectivity throughout the network operation is crucial. In this paper, we presented a local, distributed and movement efficient protocol which can handle the failure of any node in a connected WSAN. Simulation results confirmed that our approach performed very close to the optimal solution in terms of travel distance while keeping the approach local and thus minimizing the message complexity.

In addition, our approach outperformed LeDiR in terms of travel distance which requires the knowledge of 2-hops for each node.In the future, we plan to improve the travel distance performance by adapting a distributed dynamic programming approach when determining the closest dominatee.

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