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Multi Node Recovery in Wireless Sensor Actor Networks

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ABSTRACT:

In wireless sensor-actor networks, the sensors sense the surroundings and transmit the sensed data to the actors. The actor nodes respond collectively to achieve their purpose. Since the actors and sensors have to communicate at all times, a strong network topology has to be established. A failure of an actor may cause the network to be broken into two. The solution can be provided by moving actor node thus restoring connectivity. Current recovery schemes consider only single node failure. This paper overcomes this shortcoming by recovering from multiple node failures through Least-Disruptive topology Repair (LeDiR) algorithm. LeDiR algorithm depends on the local view of each node about its neighbor to find the recovery plan.

Key words: Wireless Sensor-Actor network(WSAN), Failure recovery, Cut-vertex

INTRODUCTION

Recent years Wireless Sensor and Actor Networks are gaining growing interest because of their suitability for mission critical applications that require autonomous and intelligent interaction with the environment. Examples of these applications include forest fire monitoring, disaster management, search and rescue, security surveillance, battlefield reconnaissance, space exploration, coast and border protection, etc.WSANs consist of numerous miniaturizedstationary sensors and fewer mobile actors. The sensors serve as wireless data acquisition devices for the more powerful actor nodes that process the sensor readings and put forward an appropriate numerous miniaturized stationary sensors and fewer mobile actors. The sensors serve as wireless data acquisition devices for the more powerful actor node that process the sensor readings and put forward an appropriate response. For example, sensors may detect a fire and trigger a response from an actor that has an extinguisher. Robots and unmanned vehicles are example actors in practice. Actors work autonomously and collaboratively to achieve the application mission. Given the collaborative actors operation, a strongly connected inter-actor network topology would be required at all times. Failure of one or multiple nodes may partition the inter-actor network into disjoint segments. Consequently, an inter-actor interaction may cease and the network becomes incapable of delivering a timely response to a serious event. Therefore, recovery from an actor failure is of utmost importance. The remote setup in which WSANs often serve makes the deployment of additional resources to replace failed actors impractical, and repositioning of nodes becomes the best recovery option. Distributed recovery will be very challenging since nodes in separate partitions will not be able to reach each other to coordinate the recovery process. Therefore, contemporary schemes found in the literature re-quire every node to maintain partial knowledge of the network state. To avoid the excessive state-update overhead and to expedite the connectivity restoration process, prior work relies on maintaining one- or two-hop neighbor lists and predetermines some criteria for the nodes involvement in the recovery.

Unlike prior work, this paper considers the connectivity restoration problem subject to path length constraints. In some applications, timely coordination among the actors is required, and extending the shortest path between two actors as a side effect of the recovery process would not be acceptable. Most of the existing approaches in the literature are purely reactive with the recovery process initiated once the failure of "F" is detected. The main idea is replace the failed node "F" with one of its neighbors or move those neighbors inward to autonomously mend severed topology in the vicinity of F.

Related work

A number of schemes have recently been proposed for restoring network connectivity

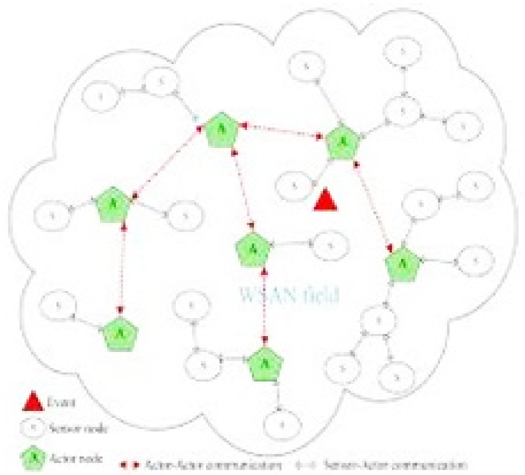

Fig. 1: An Example wireless sensor and actor network setup

in partitioned WSANs[3]. All of these schemes have focused on reestablishing severed links without considering the effect on the length of prefailure data paths. Some schemes recover the network by repositioning the existing nodes, whereas others carefully place additional relay nodes. Like our proposed DCR algorithm, DARA[8] strives to restore connectivity lost due to failure of cut-vertex. However, DARA requires more network state in order to ensure convergence. Meanwhile, in PADRA[9],identify a connected dominating set (CDS) of the whole network in order to detect cut-vertices. Although, they se a distributed algorithm, their solution still requires 2-hop neighbors information that increases messaging overhead. Another work proposed in[10] also uses 2-hop information to detect cut-vertices. The proposed DCR algorithm relies only on 1-hop information and reduces the communication overhead. Although RIM[11], C3R[12] and VCR[13] use 1- hop neighbor information to restore connectivity, they are purely reactive and do not differentiate between critical and non-critical nodes. Whereas, DCR is a hybrid algorithm that proactively identifies critical nodes and designates for them appropriate backups. The existing work on simultaneous node failure recovery proposed in[8] is a mutual exclusion mechanism called[14] in order to handle multiple simultaneous failures in a localized manner. Our proposed approach differs from MPADRA in multiple aspects. Whereas, our approach only requires 1-hop information and each critical node has only one backup to handle its failure.

System model and problem statement.

For restoring network connectivity in partitioned WSANs A number of schemes have recently been proposed. All of these schemes have focused on reestablishing severed links without

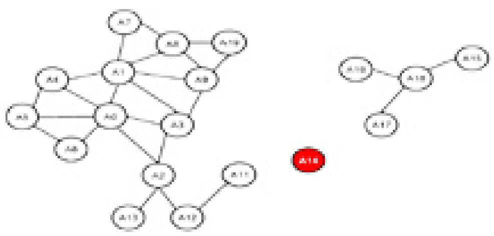

Fig. 2: Network topology and failed node

considering the effect on the length of pre-failure data paths. Some schemes recover the network by repositioning the existing nodes, whereas others carefully place additional relay nodes. On the other hand, some work on sensor relocation focuses on metrics other than connectivity, e.g., coverage, network longevity, and asset safety, or to self-spread the nodes after non-uniform deployment.

- Existing recovery schemes either impose high node relocation overhead or extend some of the inter-actor data paths.
- Existing recovery schemes focused on reestablishing severed links without considering the effect on the length of pre-failure data paths.

Proposed system

In this paper we present a new approach for multi node recovery. Previously works had been done on single node failures using Least-Disruptive topology Repair (LeDiR) algorithm.

LeDiR can recover from a single node failure at a time. Simultaneous node failures will occurs when a part of the deployment area becomes subject to a major hazardous event, e.g., hit by a bomb. Considering such a problem with collocated node failure is more complex and challenging in nature. As a next level we will implement Enhanced LeDir algorithm on Wireless sensor-actor network to overcome the multiple node failures problem with less amount of delay and to the system performance

In our base model, the researchers have considered the single node failure with the child node movement. Indeed our base model working perfectly and recovering the node failure and extend the communication throughout the network level. But the problem is while multimode failure the node movement is getting collapse. So to avoid this problem, we proposed the technique with extra actor system.

As per our base model, each actor node will scan the environment by sharing the periodic beacon information. While sharing the beacon message each actor node can know the neighbor actor availability and position of each actor node. and each actor node will store the neighbor actor availability with limited expire time for neighbor availability and route availability.

In periodic interval the neighbor actor list will be deleted based on the expired time of the actor

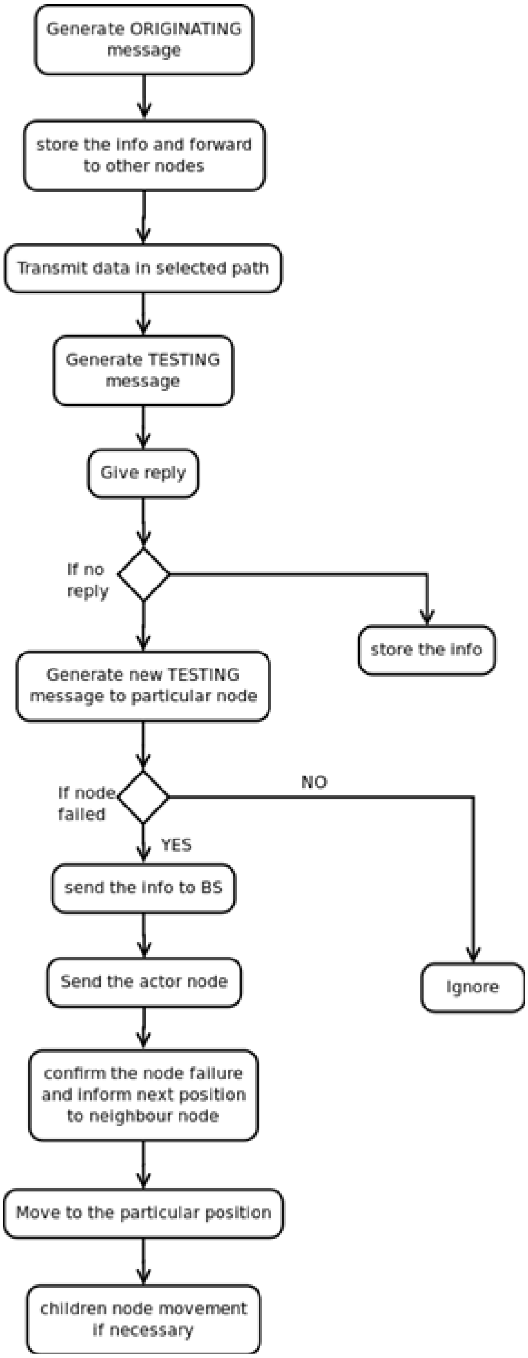

Fig. 3: Multi node recovery process

beacon information. Each time of data transmission the actor will check the neighbor actor availability in the list of neighbor actor list. In case, the deleted actor information is necessary to route the data then that actor information will be checked with the available neighbor actor's list. This information will be monitored by the base station in periodic manner by sharing the originating massage.

While the monitoring time, if base station detected multimode failure then base station will gather the information of extra actor availability. The base station will calculate the position information of multi node failure. Based on the group of node failure information and available actor position, base station will calculate the group connectivity and distance b/w each member of group node with respect to available actors. Form this calculation the base station will sort-out available extra actors with respect to failure group.

The extra actor sorting is done by the base station in two modes; one is based on the less distance and based on route connectivity. In case, there is no issue in the route connectivity of disconnected group then the extra actor will be moved towards nearest position which actor failed. The main idea for LeDiR is to pursue block movement instead of individual nodes in cascade

Implementation

In implementation we have Five steps. They are

Topology formation

To construct and maintain an efficient network topology is a very important task in wireless sensor networks. Different Wireless sensor network topologies are Bus, Tree, Star, Ring, Mesh, Circular and Grid.

Failure Detection

Actors will periodically send heartbeat messages to their neighbors to ensure that they are functional, and also report changes to the one-hop neighbors. Missing heartbeat messages can be used to detect the failure of actors. After that it's just check whether failed node is critical node or not. Critical node means if that node failed it form disjoint block in the network.

Smallest block identification

In this step we have to find smallest disjoint block. If it is small then it will reduce the recovery overhead in the network**.** The smallest block is the one with the least number of nodes. By finding the reachable set of nodes for every direct neighbor of the Failed node and then picking the set with the fewest nodes.

Replacing faulty node

If node *J* is the neighbor of the failed node that belongs to the smallest block. *J* is considered the BC to replace the faulty node. Since node *J* is considered the gateway node of the block to the failed critical node (and the rest of the network)We refer to it as "parent." A node is a "child" if it is two hops. Away from the failed node, "grandchild" if three hops.

Away from the failed node

In case more than one actor fits the characteristics of a BC (Best Candidate), the closest actor to the faulty node would be picked as a BC.

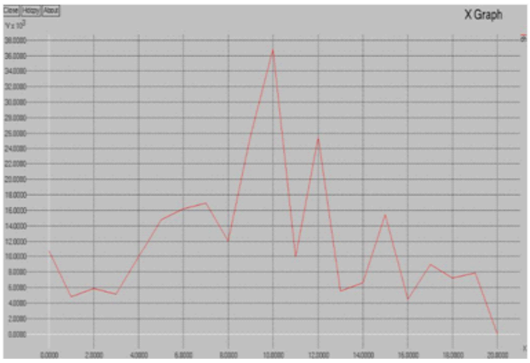

Fig. 4: Graph represents overhead

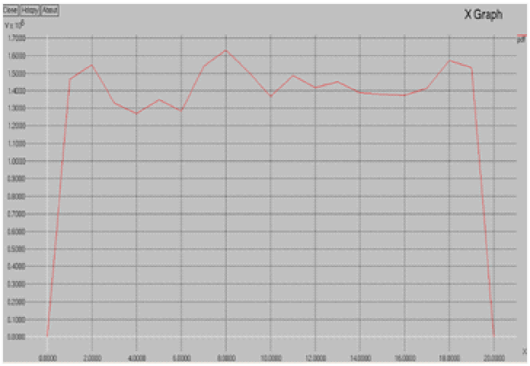

Fig. 5: Graph represents packet delivery

Any further ties will be resolved by selecting the actor with the least node degree. At last the node ID would be used to resolve the tie.

Children movement

When node *J* moves to replace the faulty node, possibly some of its children will lose direct links to it. We do not want this to happen since some data paths may be extended. This algorithm don't want to extend the link. if a child receives a message that the parent *P* is moving, the child then notifies its neighbors (grandchildren of node *P*) and travels directly toward the new location of *P* until it reconnects with its parent again. Process for multi node recovery in Wireless sensor actor networks

RESULTS

When Compared with the previous results,LeDiR reaches optimal performance. Figure 3 shows the relationship of update time with communication overhead. When number of nodes are less communication overhead increased with time and number of nodes are high communication overhead decreases with time. Figure 4 represents packet loss is very low when transmission time moves.

CONCLUSION

By using new LeDiR algorithm we can recover from multi node failures at a time.. This algorithm works efficiently when compared to maximum number of nodes and maximum number of messages exchanges is good.

REFERENCES

1. Ameer A. Abbasi, Mohamed F. Younis, *Senior Member, IEEE*, and Uthman A. Baro Recovering from node failure in wireless sensor actor networks with minilmal toplogy changes
2. F. Akyildiz and I. H. Kasimoglu, "Wireless sensor and actor networks: Research challenges," *Ad Hoc Netw. J.,* **2** (4), 351–367, Oct. 2004.
3. M. Younis and K. Akkaya, "Strategies and techniques for node placement in wireless sensor networks: A survey," *J.Ad Hoc Netw.,* **6**(4), 621–655, Jun. 2008.
4. A. Abbasi, M. Younis, and K. Akkaya, "Movement-assisted connectivity restoration in wireless sensor and actor networks," *IEEE Trans. Parallel Distrib. Syst.,* **20**(9), 1366–1379, Sep. 2009.
5. M.Younis, S. Lee, S. Gupta, and K. Fisher, "A localized self-healing al-gorithm for networks of moveable sensor nodes," in Proc. IEEE GLOBE-COM, New Orleans, LA, Nov. 1–5 (2008).
6. K. Akkaya, F. Senel, A. Thimmapuram, and S. Uludag,"Distributed recovery from network partitioning in movable sensor/actor networks via controlled mobility," *IEEE Trans. Comput.,* **59** (2), 258–271, Feb. 2010.
7. K. Akkaya and M. Younis, "COLA: A coverage and latency aware actor placement for wireless sensor and actor networks," in Proc. IEEE VTC, Montreal, QC, Canada, Sep. 1–5 (2006).
8. Abbasi, AA, Akkaya, K, Younis, M. A distributed connectivity restoration algorithm in wireless sensor and actor networks. In: Proceedings of the 32nd IEEE conference on local computer networks (LCN 2007), Dublin, Ireland; October 2007.
9. Akkaya, K, Thimmapuram, A, Senel, F, Uludag, S. Distributed recovery of actor failures in wireless sensor and actor networks. In Proceedings of the IEEE wireless communications and networking conference (WCNC 2008), Las Vegas, NV; March 2008.
10. Azadeh, Z. A hybrid approach to actor _actor connectivity restoration in wireless sensor and actor networks. In: Proceedings of the 8th IEEE international conference on networks (ICN 2009), Cancun, Mexico; March 2009.
11. Younis M, Lee S, Abbasi AA. A localized algorithm for restoring inter-node connectivity in networks of moveable sensors. IEEE Transactions on Compu-ters 2010;99(12).
12. Tamboli, N and Younis, M. Coverage-aware connectivity restoration in mobile sensor

networks. In: Proceedings of the IEEE international conference on communications (ICC 2009), Dresden, Germany; June 2009.

13. Imran, M, Younis, M, Said, AM, Hasbullah, H. Volunteer- instigated connectivity restoration algorithm for wireless sensor and actor networks. In: Proceedings of the IEEE International Conference onWireless Communications, Networking and Information Security (WCNIS 2010), Beijing, China; June 2010.
14. Akkaya K, Senel F, Thimmapuram A, Uludag S. Distributed recovery from network partitioning in movable sensor/actor networks via controlled mobility. *IEEE Transactions on Computers* ; **59**(2):258–71 (2010).
15. MilenkoJorgic ì, IS, Hauspie, Michael, Simplot-ryl, David. Localized algorithms for detection of critical nodes and links for connectivity in ad hoc networks. In: Proceedings of the 3rd annual IFIP mediterranean ad hoc networking workshop, Med-Hoc-Net, Bodrum, Turkey; June 2004.
16. Li, N Xu S, Stojmenovic, Ivan. Mesh-based sensor relocation for coverage main-tenance in mobile sensor networks. In: Proceedings of the 4th international conference on ubiquitous intelligence and computing (UIC 2007), Hong Kong, China; July 2007.
17. Ameer A. Abbasi, Mohamed F. Younis, Senior Member,IEEE, and Uthman A. Baroudi,"Recovering From a Node Failure in Wireless Sensor-Actor Networks With Minimal Topology Changes". *IEEE Trasaction on vehicular Technology,* **62** (1); 256-271 (2013).
18. Muhammad Imran a,n, Mohamed Younis b, Abas Md Said c, Halabi Hasbullah c , "Localized motion-based connectivity restoration algorithms for wireless sensor and actor networks", *Journal of Network and Computer Applications* **35**; 844–856 (2012).