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An Application Based Fault Detection and Restoration Algorithm for Wireless Sensor Actor Networks

Authors

E. Kiran Kumar[1], D.Venkatesh[2]

[1]M.Tech (Computer Science and Engineering), Student of GATES Institute of Technology, Gooty Andhra Pradesh, INDIA

Email: *kirankumar.ekkaluri@gmail.com*

[2]Associate Professor & Dean, Department of CSE & IT,GATES Institute of Technology, Gooty Andhra Pradesh, INDIA

Email: *deancseit@gmail.com*

Abstract

Wireless Sensor and Actor Networks (WSANs) is a bunch of sensors and actors joined by wireless medium to perform distributed sensing and exploit tasks. In such a network, sensors gather data concerning the physical world, whereas actors take choices and so perform acceptable actions upon the surroundings that permit remote, machine-controlled interaction with the surroundings. Actors sometimes coordinate their motion in order that they keep approachable to every different. 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 paper, a Least-Disruptive topology Repair (LeDiR) algorithmic rule [15] is presented. LeDiR may be a localized and distributed algorithmic rule [12] that leverages existing route discovery activities within the network and imposes no extra pre-failure communication overhead.

Keywords: *WSANs, LeDiR algorithm, Restoration, DCR Algorithm, DARA.*

I. 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 setting. Samples of these applications embody fire observance, disaster management, search and rescue, security police investigation, field intelligence operation, house exploration, coast and border protection, etc.

WSAN comprises varied miniaturized stationary sensors and fewer mobile actors [9]. The sensors function wireless knowledge acquisition devices for the additional powerful actor nodes that method the sensing element indications and proposes associate applicable varied miniaturized stationary sensors and fewer mobile actors.

The sensors function with wireless knowledge acquisition devices for the additional powerful actor nodes that method the sensing element indications 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 area unit example actors in observe. 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 one 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 [11] 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. 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.

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 an 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. 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 neighborhood of F.

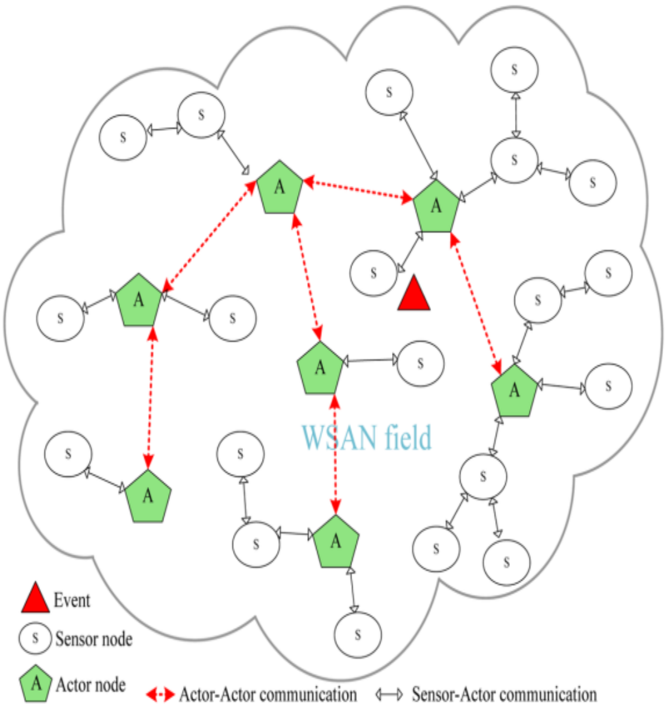

Fig: 1 An Example wireless sensor and actor network setup

II. RELATED WORK

A number of schemes have recently been planned for restoring network property in divided WSANs [1]. All of those schemes have centered on restoring cut off links while not considering the impact on the length of pre-failure data methods. Some schemes recover the network by placement the prevailing nodes, whereas others strictly place extra relay nodes.

Like our planned DCR algorithmic program, DARA 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 [2], 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 [3] 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 [5], C3R [4] and tape machine [6] 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 [15] could be a mutual exclusion mechanism known as [7] so as to handle multiple synchronic failures in a much localized manner.

Our planned approach differs from MPADRA [8] in multiple aspects. Whereas, our approach solely needs 1-hop data and every crucial node has just one backup to handle its failure.

III. PROBLEM DEFINITION AND SYSTEM MODEL

For restoring network property in partitioned off WSANs variety of schemes has recently been papered. All of those schemes have targeted on restoring 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 [14] 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 are targeted on restoring cut links while not considering the impact on the length of pre-failure knowledge ways.

Proposed system

In this paper, a tendency to gift a Least-Disruptive topology Repair [10] (LeDiR) rule is discussed. LeDiR depends on the native read of a node regarding the network to {plan|plot} a recovery plan that relocates the smallest amount range of nodes and ensures that no path between any try of nodes is extended.

LeDiR could be a localized and distributed rule that leverages existing route discovery activities within the network and imposes no further pre-failure communication overhead. The performance of LeDiR is simulated victimization NS2 machine.

Existing recovery schemes are based on restoring but not considered the impact on the length of pre-failure knowledge ways. But LeDiR algorithm is targeted on both restoration and fault detection.

The goal for LeDiR is to restore connectivity without expanding the length of the shortest path among nodes compared to the pre-failure topology. The main idea for LeDiR is to pursue block movement stead of individual nodes in cascade. Flowchart of LeDiR Algorithm is shown in fig 2.

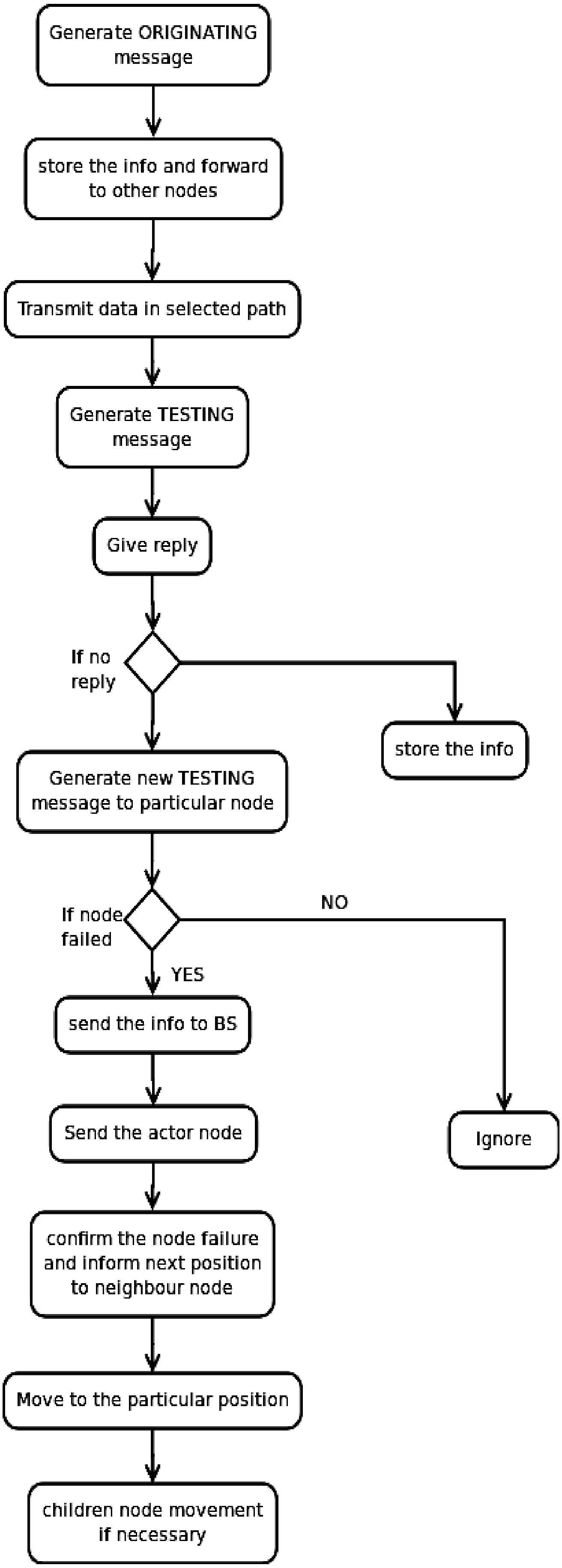

Fig 2: Flowchart of LeDiR Algorithm

Pseudocode for LeDiR Algorithm

LeDiR(*j*)
IF node j detects a failure of its neighbor F
IF neighbor F is a critical node
IF IsBestCandidate(j)
Notify_Children(j)
J moves to the position of neighbor F;
Moved_Once←TRUE
Broadcast(Msg(*RECOVERED*));
Exit;
ENDIF
ENDIF
ELSE IF j receives (a) notification message (s) from F
IF Moved _Once // Received Msg(*RECOVERED*)
EXIT
ENDIF
NewPosition←Compute_newPosition(j;
IF New Position!=CurrentPosition(j);
Notify_Children(j);
J moves to NewPosition;
Moved_Once←TRUE;
ENDIF
ENDIF

IsBestCandidate(j)

//check whether j is the best candidate for tolerating the failure
NeighborList[]←GetNeighbor(F)by accesing column F in SRT;
Smallest BlockSize←Number of nodes in the network
BestCandidate←j;
For each node I in the NeighborList[ ]
//use the SRT after excluding the failed node to find the set of reachable nodes
Number of reachable nodes ←0;
FOR each node K in SRT excluding i and F
Retrieve shortest path from I to k by using SRT
IF the retrieved shortest path does not include node f
No of reachable nodes←No of reachable nodes+1;
END IF

END FOR
IF Number of reachable nodes <Smallest BlockSze
Smallest Blocksize←Number of reachable nodes;
BestCandidate←i;
END IF
END FOR
IF Best Candidate—j
Return TRUE;
ELSE
Return FALSE;
ENDIF

Advantages

LeDiR conjointly works all right in heavy networks and pays near best performance even once nodes square measure part conscious of the configuration. It is nearly insensitive to the fluctuation within the communication vary.

IV. IMPLEMENTATION

1. Failure Detection

In this step Actors can sporadically send heartbeat messages to their neighbors to make sure that they're useful, and conjointly report changes to the one-hop neighbors. 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, smallest disjoint block is identified. 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. Smallest disjoint block is identified by finding the accessible set of nodes for each direct neighbor of the failing node then selecting the set with the fewest nodes.

3. Substitution faulty node

If node J is that the neighbor of the failing node that belongs to the tiniest block J is taken into account the B.C. to interchange the faulty node since node J is taken into account the entree node of the block to the failing vital node and the remainder of the network which talk over with it as "parent."

A node could be a "child" if it's 2 hops Away from the failing node, "grandchild" if 3 hops away from the failing node In case over one actor fits the characteristics of a B.C. (Best Candidate), the highest actor to the faulty node would be picked as a B.C... Any further ties are resolved by choosing the actor with the smallest amount node degree. At last the node ID would be accustomed resolve the tie.

4. Kids movement

When node J moves to interchange the faulty node, presumably a number of its kids can lose direct links thereto. This no need to happen since some data methods could also be extended. This rule don't need to increase the link if a toddler obtains a message that the parent P is moving, the kid then notifies its neighbors (grandchildren of node P) and travels directly toward the new location of P till it reconnects with its parent once more

V. CONCLUSION

Wireless Sensor and Actor Networks (WSANs) have initiated to obtain growing attention due to their potential in many real-time applications. A significant problem in mission critical WSANs is defined in this paper, that is, restoring network connectivity [13] after node failure without expanding the length of data paths. New distributed LeDiR algorithms that reestablish connectivity by careful shifting of nodes is proposed.

LeDiR trusts only on the local view of the network and does not impose prefailure overhead. The performance of LeDiR has been formalized through strict analysis and broad simulation experiments. This experiments are also analyzed LeDiR with a centralized version and to contemporary solutions in the literature. The solutions have showed that LeDiR is not sensitive to the fluctuations in the communication range.

LeDiR also works very hard in heavy networks and pays close to optimal performance even when nodes are partly aware of the network topology.

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AUTHOR'S PROFILE

E. Kiran Kumar graduated in Computer Science Engineering from Vaagdevi Institute of Technology & Science, Proddatur. Currently pursuing M.Tech in Computer Science Engineering from Gates Institute of Technology, Gooty. Area of interest in Computer Networks.

D.Venkatesh graduated in Master of Computer Applications and received his M.Tech from Satyabhama University and currently pursuing Ph.D from Rayalaseema University. He is associated with Gates Institute of Technology as Dean of CSE & IT Department since 2010. His area of networking includes Design and Analysis of Algorithm, Computer Networks.