ISSN No. 0976-5697
Volume 5, No. 7, September-October 2014
International Journal of Advanced Research in Computer Science
REVIEW ARTICLE
Available Online at www.ijarcs.info

A Comprehensive Review of RIM for Nodes Recovery in Wireless Sensor Networks

Parvinder Kaur[1], Alisha Saini[2]
[1] M.tech Student, [2]Assistant Professor
[1,2]Department of Computer Science & Engineering
Swami Devi Dayal Institute of Engineering & Technology-Barwala Panchkula,
Krukshetra University Krukshetra Haryana-126102 India

Abstract: The emergence of Wireless Sensor Network (WSN) has given birth to a number of diverse application that were earlier either not feasible or too expensive. Some of the applications are search and rescue, battlefield reconnaissance, surveillance, etc. The vital requisite or all these applications is interconnectivity between the various scattered nodes. Connectivity is established at network startup phase by deploying suitable topology. However there is always a chance of node failure that creates discontinuity in the network. Recovery through Inward Motion (RIM) is a distributed algorithm to restore network connectivity after a node failure. In this paper we propose to implement RIM on a simulated network and compare the results of the simulation with other node failure recovery schemes.Simulation results have shown the proposed algorithm to be efficient.

Keywords: WSN(wireless sensor network),RIM(Radial Inward Motion),LeDiR(Least-Disruptive topology Repair),TTL(Time To Live),DARA(Distributed Aggregate Routing Algo- rithm)

I. INTRODUCTION

A WSN contains different types of sensor nodes that are used to sense and transfer the information to the base station or the next neighbour node. Recent technologies made it possible to minimise the cost and the bulkiness of the electronic devices. The wide range of sensors is available such as humidity, movement, temperature, pressure, and lightening conditions are monitored. Lower Power consumption restricts sensor to use the limited resources such as less low transmit power, memory requirement and less processing calculation. The aims is to provide better end-to-end delay, less number of dead nodes, a higher output, and overall lower power consumption compared to other protocols.

A state-of-the-art technology Wireless Sensor Networks (WSNs) is used to sense the data from all locations. Different parts of sensor nodes can be classified in six major units:

a. Communication Unit
b. Processing Unit
c. Sensing Unit
d. ADC/DAC Converters
e. Power Supply
f. Temporary Storage Unit

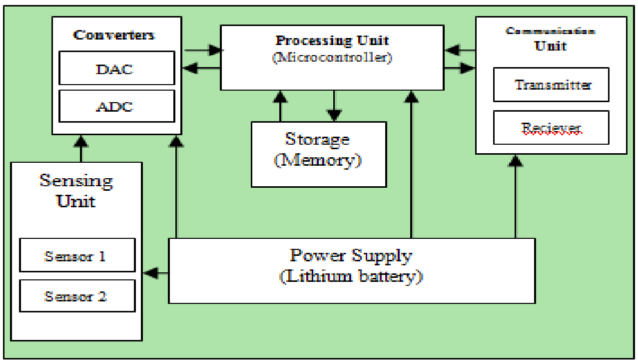

Figure 1: General Architecture

Fig[1]. shows general architecture of sensor nodes. The sensors in the sensing unit interact physically with the environment. The sensed data is send to the ADC/DAC converters. The micro-controller receives digital data and does the required processing by using the temporary memory. The processed data are then transmitting to the transmitter of the communication unit for transmission towards the cluster head. On the other hand, the data from the Cluster Head is received by the receiver and then transferred to the processor for further processing. The power source used in sensor node can be a lithium battery.

The two main parts where most of the power consumption occurs are:

a. The processing units and
b. The communication Unit.

The cluster head is either a mobile or fixed node, which has the capability to connect the sensor network to the internet where the user can access and process the data. Routing in WSNs is very essential due to the inherent traits that distinguish this network from other wireless networks or cellular networks. Limited memory and power are the parameters which affect the amount of data to process or store in an individual node. The architecture of typical WSN is shown in Figure 1.2.

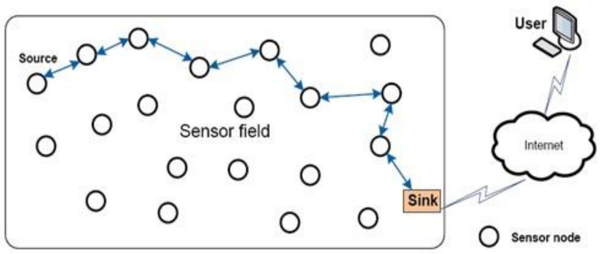

Figure 2: Wireless Sensor Network

The various areas including industry, commercial sector, or military fields are increasing its use rapidly all over the world. Healthcare becomes other area in industry and commercial sector where WSNs are being deployed.

The deployed sensors help the hospitals and operators to monitor the patient's vital signs. The node recovery schemes are being discuss in section II. Mainly we are focus on Rim and LediR technique .we also compare these two in their performance in certain parameter.

II. RELATED WORK

In this paper,Mohamed Younis, Sookyoung Lee, Sheetal Gupta and Kevin Fisher[1] discuss the effectiveness of wireless sensor networks (WSNs) deployed in search and rescue, battlefield reconnaissance, surveillance, and other applications depends on inter-node interaction and maintaining network connectivity. While connectivity can be provisioned at start-up, then sustained through careful coordination when nodes move, the network can be partitioned if a node suddenly fails. This paper presents Recovery through Inward Motion (RIM), a distributed algorithm to efficiently restore network connectivity after a node failure. Instead of performing a network-wide analysis to assess the impact of the node failure and set a course of action, RIM triggers a local recovery process by relocating the neighbours of the lost node. RIM minimizes messaging overhead and reduces the distance that individual nodes travel during the recovery.

In this paper, Ameer A. Abbasi, Mohamed F. Younis and Uthman A. Baroudi[2] discuss that in wireless sensor-actor networks, sensors probe their surroundings and forward their data to actor nodes. Actors collaboratively respond to achieve predefined application mission. Since actors have to coordinate their operation, it is necessary to maintain a strongly connected network topology at all times. Moreover, the length of the inter-actor communication paths may be constrained to meet latency requirements. However, a failure of an actor may cause the network to partition into disjoint blocks and would, thus, violate such a connectivity goal. One of the effective recovery methodologies is to autonomously reposition a subset of the actor nodes to restore connectivity. Contemporary recovery schemes either impose high node relocation overhead or extend some of the inter-actor data paths. This paper overcomes these shortcomings and presents a Least-Disruptive topology Repair (LeDiR) algorithm. LeDiR relies on the local view of a node about the network to devise a recovery plan that relocates the least number of nodes and ensures that no path between any pair of nodes is extended. LeDiR is a localized and distributed algorithm that leverages existing route discovery activities in the network and imposes no additional pre-failure communication overhead. The performance of LeDiR is analyzed mathematically and validated via extensive simulation experiments.

In this paper, A. Alfadhly, U. Baroudi and M. Younis[4] discuss in most applications of Wireless sensor and actor network it is important to sustain connectivity among all actors at all times. When an actor fails the inter-actor topology may get partitions into disjoint blocks and the application may be negatively impacted. Tolerating the actor failure and restoring the lost connectivity need to be performed while imposing the least overhead on the individual actors. In this paper a Least Distance Movement Recovery (LDMR) algorithm is proposed. LDMR is a distributed approach that exploits non cut-vertices actors in the recovery process. The idea is for a set of direct neighbours of the failed node to move toward the position of the failed node while its original position is replaced with the nearest non cut-vertex actor. The recovery process starts with the search phase where each neighbour broadcasts a message containing the failed node ID, neighbour node ID and, Time-To-Live (TTL). When a neighbour receives responses, it chooses the best candidate based on a certain criteria (e.g. distance).

In this paper, Movement-assisted connectivity restoration in wireless sensor and actor networks, A.A. Abbasi, M. Younis and K. Akkaya[3] discusses that in WSAN applications, a set of mobile actor nodes are deployed in addition to sensors in order to collect sensors' data and perform specific tasks in response to detected events/objects. In most scenarios, actors have to respond collectively, which requires inter-actor coordination. Therefore, maintaining a connected inter-actor network is critical to the effectiveness of WSANs. However, WSANs often operate unattended in harsh environments where actors can easily fail or get damaged. An actor failure may lead to partitioning the inter-actor network and thus hinder the fulfilment of the application requirements. In this paper, we present DARA, a distributed actor recovery algorithm, which opts to efficiently restore the connectivity of the inter-actor network that has been affected by the failure of an actor. Two variants of the algorithm are developed to address 1- and 2-connectivity requirements. The idea is to identify the least set of actors that should be repositioned in order to re-establish a particular level of connectivity. DARA strives to localize the scope of the recovery process and minimize the movement overhead imposed on the involved actors. The effectiveness of DARA is validated through simulation experiments.

III. COMPARISION BETWEEN RIM AND LEDIR

A. *RIM:*

This paper presents review of RIM: a distributed algorithm for Recovery through Inward Motion. RIM restores the connectivity of a WSN through the efficient repositioning of some of its nodes. RIM is a localized scheme that limits the scope of the recovery process. The main idea is that when a node fails, its neighbors move inward toward its position so they can connect with each other. The rationale is that these neighbors are the ones directly impacted by the failure, and when they can reach each other again, the network connectivity is restored to its pre-failure status. The relocation procedure is recursively applied to handle any nodes that get disconnected when one of their neighbors moves

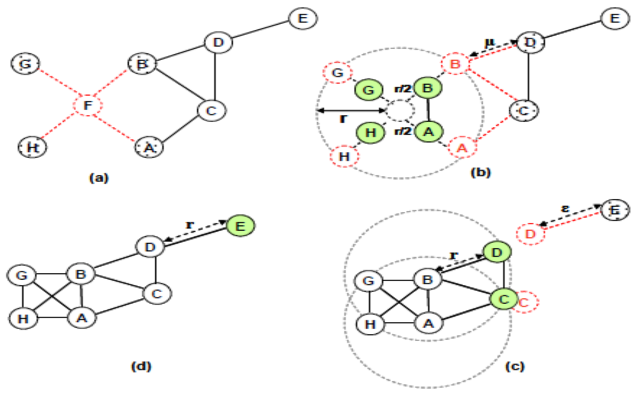

Figure 3: Working of RIM scheme

Fig 3 shows how does RIM scheme work in WSN. . The procedure is as follows:

a. One-hop neighbour table maintenance: When a network is setup, each node broadcasts a start message and receives response from its immediate neighbours. According to the response received each neighbor maintains a table of its immediate neighbours which is known as one-hop neighbour table.
b. Failure detection: A short message known as heartbeat message is broadcast at regular fixed intervals. The neighbour nodes detect this heartbeat message. When the neighbour node stop detecting heartbeat message a failed node is detected.
c. Recovery process initiation: The actor node closest to the failed node moves to take place of the failed node. This actor node is termed as parent node. The nodes opposite to the direction of motion of parent node are termed as child nodes. These child nodes move in the same direction as the parent node by the same distance as moved by parent node.
d. Cascaded node relocation: Recursive motion of child nodes in the direction of the failed node. These child nodes move by same distance as moved by parent node. This covers the hole created by the failed node. However the child node movement shrinks the boundary of the network.

RIM is simple and effective. It employs a simple procedure that recovers from both serious and non-serious breaks in connectivity, without checking to see if the failed node is a cut vertex. The entire recovery process is distributed, enabling the network to heal itself without external supervision.

B. LeDiR:

The goal for LeDiR is to restore connectivity without extending the length of the shortest path among nodes compared to the prefailure topology.

The following highlights the major steps.

a. ***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. Once a failure is detected in the neighborhood, the one-hop neighbors of the failed actor would determine the impact, i.e., whether the failed node is critical to network connectivity. Basically, a cut vertex *F* has to be on the shortest path between at least two neighbors of *F*. After the failure of actor

*A*19, which is a cut vertex, node *A*20 will check what nodes are reachable through *A*19, which are *A*8 and *A*9 in this example. Checking the entries for nodes *A*8 and *A*9 reveals that *A*1, *A*3, *A*7, and *A*10 will become consequently unreachable. The same is repeated and finally leads node *A*20 to conclude that only *A*21 is reachable and *A*19 is indeed a critical node.

b. ***Smallest block identification*:** LeDiR limits the relocation to nodes in the smallest disjoint block to reduce the recovery overhead. The smallest block is the one with the least number of nodes and would be identified by finding the reachable set of nodes for every direct neighbor of the failed node and then picking the set with the fewest nodes.

Since a critical node will be on the shortest path of two nodes in separate blocks, the set of reachable nodes can be identified

In other words, two nodes will be connected only if they are in the same block. For example, let us again consider the network topology provided in Fig. and assume that node *A*19 failed. When nodes *A*8, *A*9, and *A*20, the one-hop neighbors of *A*19, confirm that *A*19 is indeed a cut vertex (critical node), they will be able to identify the disjoint blocks. For *A*20, the analysis of the cut vertex detection step discussed previously will conclude that *A*20 can reach only *A*21, and thus, *A*20 and *A*21 constitute a block. Now, *A*20 would check the column of *A*19 and find out that *A*8 and *A*9 are the other direct neighbors of *A*19. Node *A*20 will then repeat the analysis and identify the other disjoint block(s) and determine the smallest block after *A*19 fails. Now, *A*20 will lead the recovery effort if it happens to belong to thesmallest block, which is the case in this example.

c. ***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, and so on. The reason for selecting *J* to replace the faulty node is that the smallest block has the fewest nodes in case all nodes in the block have to move during the recovery. As will be shown later, the overhead and convergence time of LeDiR are linear in the number of nodes, and thus, engaging only the members of the smallest block will expedite the recovery and reduce the overhead.
d. ***Children movement*:** When node *J* moves to replace the faulty node, possibly some of its children will lose direct links to it. In general, we do not want this to happen since some data paths may be extended. For example, in Fig. 2, the path between *A*2 and *A*3 get extended because *A*2 lost its link to *A*12 after *A*12 had moved. LeDiR opts to avoid that by sustaining the existing links. Thus, 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.

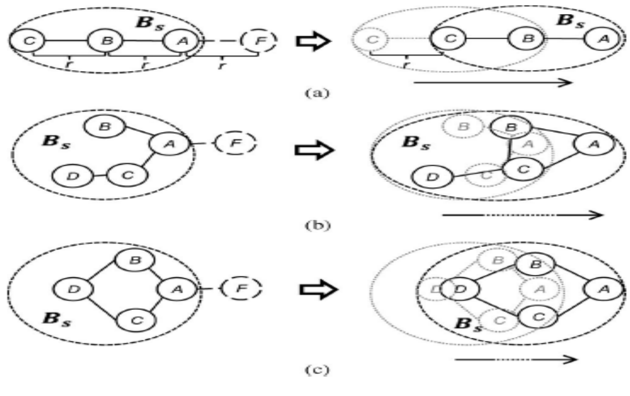

Figure. 4 Movement of block *Bs* in LeDiR to restore the network connectivity and to keep intrablock paths unchanged. (a) That entire *Bs* moved *r* units. (b) The collective effect of *Bs* participation in the recovery is stretching *Bs* toward *F*. (c) *Bs* is both stretched and moved with links within the *Bs* stretched to minimize the total travel distance. *r* is the actor’s communication range.

IV. CONCLUSION

This paper is brief review of Node recovery schemes in Wireless Sensor Network . Each scheme has its own advantages and disadvantage. Comparison of recovery scheme are given in working and distance moved. This also discusses in detail about LeDiR and RIM techniques. This paper resolve the problem in WSNs, that is, re establishing network connectivity after node failure without extending the length of data paths. The RIM algorithm identifies critical actors in advance based on localized information and designates for them backup actors. In order to handle multiple simultaneous failures of critical actors, we consider RIM to better. RIM can handles failure scenarios in which two adjacent nodes simultaneously fail.But LeDiR can not do so.Thus, Compared with other similar algorithms, RIM proves to be a better selection for maintaining the topology.

RIM minimizes messaging overhead and reduces the distance each individual node travels during the recovery. The overall distance moved , no of nodes moved and path extended is reduced

V. FUTURE SCOPE

In the future,We can work further on the implementation to improve the algorithm. Our further investigations include experiments with high network load and different topology Additionally, analysis of the maintenance of the proposed algorithm is needed. The parent node selection is based only on distance from node failure site. However, traffic load on nodes should also be considered for parent node selection. This will remain the area of future scope.

VI. REFERENCES

[1]. Mohamed Younis, Sookyoung Lee, Sheetal Gupta and Kevin Fisher,"A Localized Self-healing Algorithm for Networks of Moveable Sensor Nodes", "GLOBECOM" 2008 proceedings..pp:1-5

[2]. 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 TRANSACTIONS ON VEHICULAR TECHNOLOGY, VOL. 62, NO. 1, JANUARY 2013,pp:256-271

[3]. Abbasi, A.A. ; Younis, M. ; Akkaya, K. Movement-Assisted Connectivity Restoration in Wireless Sensor and Actor Networks ,Parallel and Distributed Systems, IEEE Transactions on (Volume:20 , Issue: 9)),Sept. 2009, pp:1366 - 1379

[4]. Alfadhly, A.; Baroudi, U.; Younis, M. "Least Distance Movement Recovery approach for large scale Wireless sensor and actor networks "Wireless Communications and Mobile Computing Conference (IWCMC), 2011 7th International ,4-8 July 2011,pp:2058 - 2063

