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A review on recovery of node failure in Wireless Sensor Network

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Abstract: *The modern era is witnessing a widely used concept of Wireless Sensor Network(WSN).This application is mostly used in sectors of remote and industrial areas where human intervention is very difficult to implement. Timely detection of active failures in such areas is very important as these failures could partition the network into several disjoint networks. Wireless active sensor networks (WSAN) consists of group of actors and sensor nodes. Actors are the individual network nodes that behave according to the directions given by the sensors. Sensor nodes sense the background environment in the network and provide the network information to the actor nodes. If the failure in the network node is not detected in time, it could partition the network into disjoint sets. There are several algorithms and methods that are proposed by various authors. The various algorithms implemented till date are the concept of LeDir(Least Disruptive Topology Repair Algorithm),CD(Cut Vertex)algorithm, RIM(Reverse Invert Motion) algorithm, DARA(Divide actor recovery algorithm),PDARA(Partition detection actor recovery algorithm etc. Thesealgorithms are based on two strategies of node repositioning and inward motion. This review paper deeply studies the methods that are proposed by various authors for the detection and recovery of actor failures in mobile sensor networks.*
Keywords: *LeDir, DARA, CD, RIM, PDARA*

I. INTRODUCTION

Modern years have witnessed a mounting interest in the applications of wireless sensor-actor networks (WSANs). Of particular interest are applications in remote and hard areas in which human intervention is risky or impractical. Examples include space exploration, battle field surveillance, search-and-research, costal and border protection; today such networks are used in many industrial and consumer applications.

A wireless sensor network (WSN) (sometimes called a wireless sensor and actor network (WSAN) are spatially distributed autonomous sensors to *monitor* physical or environmental conditions such as temperature, sound, pressure, etc. and to cooperatively pass their data through the network to a main location. The more modern networks are bi-directional, also enabling *control* of sensor activity. The development of wireless sensor networks was motivated by military applications such as battlefield surveillance; today such networks are used in many industrial and consumer applications, such as industrial process monitoring and control, machine health monitoring, and so on.

A WSN can be defined as a network of devices, denoted as nodes, which can sense the environment and communicate the information gathered from the monitored field by way of wireless links]. The data is forwarded, possibly via numerous hopsto a sink that can use it locally or is connected to other networks (e.g., the Internet) through a gateway. The nodes may be motionless or movable. Each node can be awake of their locality or not.A sensor network is a network of tiny, lightweight, battery-operated devices, known as sensor nodes. Each sensor node in a sensor network is also equipped with wireless-communication devices. Sensor networks are usually deployed with an intention of monitoring some kind of physical phenomena from the territory of the deployment. For example, a sensor network may be deployed somewhere to monitor the humidity or the temperature of the surrounding area.

In wireless Sensor Networks (WSANs) it is necessary to maintain a powerfully connected network topology at all times. In most applications, the inter-actor Co-ordination is necessary to provide the best performance. There are several faults could lead to failures in wireless sensor networks. WSN node faults are usually due to the following causes: the failure of modules (such as communication and sensing module) due to fabrication process problems, environmental factors, enemy attacks and so on; battery power depletion; being out of the communication range of whole network. However, a failure of node may cause the network to partition into disjoint blocks and would, break such a network connectivity goal. Failed nodes may decrease the quality of service (Qos) of the entire WSN.The main objective of this paper is to provide a complete survey on node recovery from a failure in wireless sensor networks. Thereare several schemes has been proposed for node recovery from failure.

II. RELATED WORK

[1] N Bala Kumar in his paper presented the basis of Least Disruptive Topology Repair algorithm(LeDir).His paper says that LeDir is a localized and distributed algorithm that works with less number of existing communication overheads and works to detect the failure in existing network. WSAN works with the collection of actors and sensors that permit remote machine-controlled interaction with the surroundings. His paper overcomes the existing problems by the implementation of LeDir method. LeDir focuses on local view of the network and devise a plan that recovers the failure by relocating least number of nodes so that the existing network remains unaltered or unextended. He has analysed the performance of LeDir mathematically and his results are also validated.

[2] This paper presents a review of three approaches LeDir, Rim and DARA. These approaches have been studied and these performance metrics have been evaluated.

Property	LeDir	RIM	DARA
Maximum number of nodes to be involved	1/2(N-1)	N-1	N-3
Maximum messages to be sent	3/2(N-1)	2N-1	5N-3
Maximum distance travelled by a node	R	r/2	r
Maximum Distance travelled by all	r/2(N-1)	r/2(N-1)	
engaged nodes	≈1/2 r N	≈1/2 r N	r(N-3)≈rN

Table 1. Analytical performance of LeDiR, RIM, and DARA.Where N represents number of deployed nodes and r represents communication range

[3]. I.F.Akyildiz in his paper has finded a solution to one of the most crucial problem in mission critical WSA N which is re-establishing of failed node in a network without extending the path. It carefully repositions the node. It also states that LeDir relies on local view of network and does not impose prefailure overhead. The experiments have also compared LeDir with a centralized version and its results are evaluated. The results of this paper shows that LeDir is almost insensitive to the variation in the communication. It also works well in the dense network and yields close to optimal performance even when nodes are partially aware of network topology. LeDir can recover from a single node at a time. Simultaneous nodes are almost impossible to recover from unless a part of deployment area becomes subject to major hazardous event.

[6]. Two fundamental functions of the sensor nodes in a wireless sensor network are to sense its environment and to transmit sensed information to a base station. One approach to prolong sensor network lifetime is to deploy some relay nodes whose main function is to communicate with the sensor nodes, other relay nodes, and the base stations. It is desirable to deploy a minimum number of relay nodes to achieve certain connectivity requirement. In this paper, we study four related fault-tolerant relay node placement problems, each of which has been previously studied only in some restricted form. For each of them, we discuss its computational complexity and present a polynomial time O(1)-approximation algorithm with a small approximation ratio. When the problem reduces to a previously studied form, our algorithm either improves the previous best algorithm or reduces to the previous best algorithm.

[7] In this paper, the background environment of Wireless sensor network is considered and taking that into account an effective strategy is proposed for maintaining the actual connectivity in a network. For restoring the connectivity among these segments by populating the least number of relay nodes. Finding the optimal count and position of relay nodes is NP-hard and heuristics are thus pursued. We propose a Distributed algorithm for Optimized Relay node placement using Minimum Steiner tree (DORMS). Since in autonomously operating WSNs it is infeasible to perform a network-wide analysis to diagnose where segments are located, DORMS moves relay nodes from each segment toward the centre of the deployment area. As soon as those relays become in range of each other, the partitioned segments resume operation. DORMS further model such initial inter-segment topology as Steiner tree in order to minimize the count of required relays. Disengaged relays can return to their respective segments to resume their pre-failure duties. We analyze DORMS mathematically and explain the beneficial aspects of the resulting topology with respect to connectivity, and traffic balance. The performance of DORMS is validated through extensive simulation experiment

[8]In this paper presented by A.Akkaya, he has highlighted how the recovery could be made in movable sensor networks by utilizing distributed approach. The operations of successful data transfer between source and destination and the communication basically relies on the accurate connectivity among the nodes in a network. The failure of even a single node can result into the partition among the network thereby reducing the quality and efficiency in a network. In this paper, the mechanism of PADRA (Partition and Distributed recovery of actor nodes) is presented which is able to detect possible partitions and restore the network connectivity

through controlled relocation of actor nodes. The PADRA works by identifying the failure first. It checks whether any node can cause failure. If such node is detected, it designates a failure handler to initiate the connectivity restoration process. The overall goal in this process is to localize the scope of recovery and minimize the overhead occurred on node.

[9] This paper says that the realization of wireless sensor and actor networks (WSANs) needs to satisfy the requirements introduced by the coexistence of sensors and actors. In WSANs, sensors gather information about the physical world, while actors take decisions and then perform appropriate actions upon the environment, which allows a user to effectively sense and act from a distance. In order to provide effective sensing and acting, coordination mechanisms are required among sensors and actors. Moreover, to perform right and timely actions, sensor data must be valid at the time of acting. This paper explores sensor-actor and actor-actor coordination and describes research challenges for coordination and communication problems.

III. DISCUSSION AND CONCLUSION

In recent years, Wireless Sensor Networks have started to receive growing attention due to their potential in real-time applications. In this paper, we discussed an important issue in WSNs that is node recovery from a failure. As mentioned earlier, in wireless sensor networks the node restoration and recovery from a failure is an active area for research. This survey provides a valuable ideas and suggestions about node recovery process after failure in wireless sensor network.From this survey, we studied, there are some common problems in all the above mentioned approaches and other previous method have been analysed and discussed that only single node failure are majorly focussed and multiple node failure are not addressed. All the schemes do not have any idea about simultaneous node recovery. Another major thing is that many of the approaches could not consider the topology management while recovering a node from a failure in WSNs.

From this survey, we get some important points for future work. In future we discuss the chances of occurrence of multiple node failure and will analyze how to completely recover from all failures of a node at a time i.e. simultaneously in wireless sensor networks with the use of movable nodes.

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