Chapter 10
Wireless Sensor and Actuator Networks-Based Reliable Data Acquisition Mechanism

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ABSTRACT

The objective of deploying a wireless sensor network is to collect data about the environment in which it will be utilised and then to transmit that data to a distant sink where it will be used to estimate or reconstruct the environment or event. In order for the centralised sink to be able to accurately reconstruct or estimate the event and take the necessary actions on time, the wireless sensor and actuator network must be able to guarantee delivery of a sufficient amount of the information gathered by the deployed sensor nodes in a time-bound and coherent manner. In addition to the above-mentioned fundamental problem, reliability also refers to the network's capacity to tolerate defects up to a certain point without compromising performance. This chapter introduces a brand-new, dependable data acquisition technique that makes use of wireless sensor and actuator networks.

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INTRODUCTION

A Wireless Sensor Network (WSN) is deployed with the purpose of acquiring information and then passing on the acquired information to a remote sink where the information can be used to estimate or re-construct the environment or event. This requires the WSN to have the ability to sense the parameter or event under consideration, in the region of deployment, and then ensure reliable delivery of the information to a centralized sink where the information sensed by it can be used to re-construct the events (Abroshan, S., & Moghaddam, M. H. Y. 2014). However, in context of the Wireless Sensor & Actuator Networks the Network Latency time assumes much greater importance since the action taken by the Actuator nodes has to be time coherent with the event sensed by the deployed nodes failing which the control loop will become un-stable and erratic.

This chapter presents a novel Reliable Data Acquisition methodology using Wireless Sensor & Actuator Networks which meets the criterion of reliability as mentioned above. The proposed methodology, ensures, regarding a sensed event is reported to the centralized sink / Actuators for acceptable estimation or re-construction of the event detected, within the time constraint fixed by the control action to be taken by the Actuator nodes.

The objective in this approach is for the Sensor Network to continue its operation with as high reliability as is feasible under the given fault condition in the network (Adelstein, 2005). The fault conditions could vary from temporary loss of communication between a set of nodes, to permanent loss of a node because of damage or end of battery life of the node. The focus of design of algorithm tends to be on ensuring detection of event and then delivery of sensed despite the fault condition. Some algorithms also focus on detection of fault condition itself and then managing it.

Majority of these solutions propose algorithms with the ability to dynamically find alternate network paths in case a given network becomes un-usable because of a fault condition. Many algorithms present methodology where the data sensed is transferred on multiple paths simultaneously to begin with thus ensuring delivery of information at sink despite some path becoming useless because of node failure (Ali, S., Fakoorian, A. & Taheri, H. 2017).

These methods compute reliability for multiple paths depending upon status of nodes and send data on most reliable path or broadcast data on multiple routes with probabilistic approach for success. Some algorithms use Centralized or distributed approach to fault detection based on historic data or location-awareness. However, these set of methods tend to be highly memory & computational intensive thus putting significant load on the nodes and increasing the computational delays and reduction in life of the node (Alsbouí, T.A. 2019). The tolerance to node fault is

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