International Journal of Sensor Networks and Data Communications

Aparicio, Int J Sens Netw Data Commun 2018, 7:1
DOI: 10.4172/2090-4886.1000e112

Editorial Open Access

The Use of WSNs for Structural Health Monitoring

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Received date: August 01, 2017; **Accepted date:**August 02, 2017; **Published date:**August 14, 2017

Citation: Aparicio S (2018) The Use of WSNs for Structural Health Monitoring. Int J Sens Netw Data Commun 7: e112. doi:10.4172/2090-4886.1000e112

Editorial

A Wireless Sensor Network (WSN) is a set of nodes, commonly called motes that communicate wirelessly with each other. These nodes consist mainly of a microcontroller equipped with sensors and a radio chip. In this type of networks a node is in charge of collecting all the information of the network and is called gateway or base station.

The routing topology, i.e., the path to be followed by the information transmitted by each node to reach the base and transmit it to the user, is determinant for the operation of the network. There are different topologies-star, tree, mesh, etc. that are suitable for each type of application. Once the data is received through the gateway, the information must be stored, processed, analyzed and presented to the user in the most appropriate way, and sometimes it is very important that this is done in real time.

Advances in wireless communication and microelectronic devices have led to the development of low-power sensors and the large-scale deployment of sensor networks. This is due, mainly, to its low cost, its ease of deployment and to be self-configurable, being able to become at any moment emitter or receiver, as well as to record data referring to the local sensors of each node. Another important feature is the efficient management of energy since these networks must have a high autonomy rate to be fully operational for long periods of time.

Therefore one of its main disadvantages is the energy consumption, which must be limited since it has to combine autonomy with process capacity. This limitation affects the radio hardware and transceiver, which should be as simple as possible, leading to limited process capability. It is also necessary to take into account the vulnerability of the nodes, making security one of the most important keys in this type of networks.

There are different commercial algorithms for the routing of information between nodes, but it is still necessary to improve them since, depending on the application, the message failure rate is still high. An improvement of the algorithms also has an impact on the reduction of energy consumption of the network, efficiency and better adaptation to specific applications.

Sensor networks are a relatively new concept in the acquisition and processing of data with multiple applications in different fields such as industrial environments, home automation, military applications, environmental detection, etc.

In the construction sector, the professor Lynch of the University of Michigan established in 2000 for the first time the advantage of using WSNs for structural health surveillance (SHM) of bridges through the use of new MEMS sensors [1]. Also noteworthy is the contribution of C. Grosse and M. Krüger who started in 2003 the project FPT6 "Sustainable Bridges" where they designed and performed several demonstrators using WSNs [2]. Finally, in 2005 B. Phares from the University of Iowa presented a report titled "Health Monitoring Bridge structures and components using Smart Structure Technology" where the state of the USA bridges as well as a remarkable compendium of new technologies for SHM were studied [3]. In this report, the use of WSNs was presented as one of the most promising technologies. Since the beginning of the use of WSNs, different investigations were carried out in order to improve its operation and to evaluate its limits and utilization. The main studies can be grouped in the following fields:

- Optimization of processing resources, memory and bandwidth.
- Energy consumption: Optimization of work cycles and energy "harvesting" systems.
- Routing protocols: Development of algorithms, topologies and evaluation of their performance.
- Propagation and interference of RF signals will depend on the environmental and structural conditions where the WSNs are deployed.
- Loss of messages: Message loss analysis and strategies of decision for this loss. Knowing the reason of the message loss in real applications can improve the transmissions.
- Security, cryptographic algorithms appropriate to the restrictions of the WSNs.
- Real-time requirements: Necessary when the response to sensory information requires a response in a limited time, for example generation of alarms.
- Analysis of the information: How to use the information generated by the WSNs to characterize the materials. For example, using Big DATA Techniques.
- Therefore, it is still necessary to continue investigating about how to improve these aspects depending on the application that it is studied.

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