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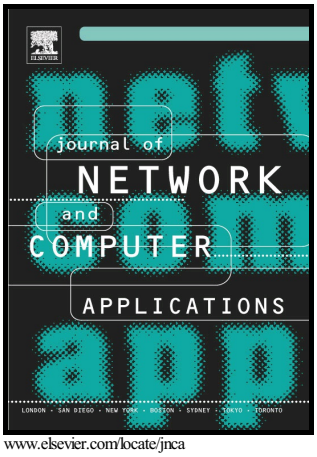

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Survey and Systematic Mapping of Industrial Wireless Sensor Networks

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Abstract

The Wireless Sensor Network (WSN) is an infrastructure comprised of sensing, computing, and communication devices, that obtain and process data to help understand the behavior of the monitored environment, and to react to events and phenomena that occur in it. The WSN can be used in domains such as agriculture, energy, industrial automation, medical health care, smart building, and so on. In industry, the characteristics of the wireless channel are different in comparison to other WSN environments, such as home and office environments. The use of WSN in industry is subject to typical problems of wireless communications, such as noise, shadowing, multipath fading and interference. In addition, the wireless channel in many industrial environments is non-stationary for a long term, which can cause abrupt changes in the characteristics of the channel over time. A set of standards was developed for industrial WSN, to overcome these limitations, such as WirelessHART, ISA100.11a, WIA-PA, and IEEE 802.15.4e. All the mentioned standards are based on the IEEE 802.15.4 physical layer, but define different mechanisms for the upper layers. However, according to recent publications, problems still can arise in the deployment of networks that follow the standards, because of multipath effects, and interference. This survey provides a structured overview of the standards used to implement industrial WSN, their advantages and drawbacks, and discusses the characteristics of the wireless channel in industrial environments. Finally, a systematic mapping is described, that presents results of publications about industrial WSN, and highlights important topics to be studied in this field.

Keywords:
industrial wireless sensor networks; survey; systematic mapping.

1. Introduction

Traditionally, industrial monitoring systems work offline or use wired networks to transmit the information to a central station. In monitoring systems based on wired networks, the installation process of cables and sensors usually has higher cost than the sensors themselves [1]. Moreover, this approach has limited flexibility, which makes the process of installation and maintenance of the network more difficult and expensive.

An alternative to implement systems that present lower cost, is the use of wireless networks, which have significant advantages, including high flexibility, reconfigurability, easy installation and maintenance [2]. More specifically, the Wireless Sensor Networks (WSN) have other advantages, such as the ability of self-organization and local processing, appearing as a promising platform for the implementation of monitoring and controlling systems in industrial environments.

The WSN nodes are equipped with sensors (or actuators), and present processing capabilities. They have resource constraints, with low processing power and, in some cases, restrictions in power consumption. In industry, sensors are deployed to monitor critical parameters such as vibration, temperature, pressure and motor efficiency [3]. The measurements obtained by the sensors are transmitted wirelessly to a sink node, which provides the information for analysis by a monitoring central, or to be used in control systems. In some

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