

Chapter 15

Event Detection in Wireless Sensor Networks

Sohail Anwar

Penn State University, USA

Chongming Zhang

Shanghai Normal University, China

ABSTRACT

Wireless Sensor Networks (WSNs) have experienced an amazing evolution during the last decade. Compared with other wired or wireless networks, wireless sensor networks extend the range of data collection and make it possible for us to get information from every corner of the world. The chapter begins with an introduction to WSNs and their applications. The chapter recognizes event detection as a key component for WSN applications. The chapter provides a structured and comprehensive overview of various techniques used for event detection in WSNs. Existing event detection techniques have been grouped into threshold based and pattern based mechanisms. For each category of event detection mechanism, the chapter surveys some representative technical schemes. The chapter also provides some analyses on the relative strengths and weaknesses of these technical schemes. Towards the end, the trends in the research regarding the event detection in WSNs are described.

INTRODUCTION

Wireless Sensor Networks (WSNs) have gained significant attention in recent years, particularly with the proliferation of Micro-Electro-Mechanical Systems (MEMS) and with the advances in Nanotechnology which facilitated the development of compact and diverse sensors. These sensors are small nodes, with limited computing

resources and low cost hardware design. Thus, they are inexpensive compared to traditional sensors. These sensor nodes can sense, measure, and gather information from the environment. Then, based on some local decision process, they can selectively transmit the sensed data to the user (Yick, Mukherjee, & Ghosal, 2008).

A wireless sensor network (WSN) in its simplest form can be defined as a network of devices called nodes that can sense the physical world and communicate the information gathered from the

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monitored field (for example, an area or volume) through wireless links. Each node comprises components including controller, memory, communication, power supply and sensors. Original sensor data or some kind of processed and condensed information is forwarded, possibly via multi-hop relaying, to a sink node or base station, which can use it locally or route it to other networks through a gateway (Verdone, Dardari, Mazzini, & Conti, 2008). Although motion is possible, the nodes are generally static. They may or may not be aware of their location.

The typical deployment scenario of WSN is depicted in Figure 1, where a number of sensor nodes are scattered in the monitored field. The sensor nodes collect data from the field and route the data to a sink node, which further relays the data to an infrastructure network. More than one sink is possible in some WSN applications.

The ideal wireless sensor node is smart and software programmable, consuming very little power, capable of fast data acquisition, reliable, inexpensive, and needing little maintenance (Lewis, 2004). Unlike traditional wired and wireless networks, a WSN has its own unique design and resource constraints. Resource constraints include limited amount of energy, short communication range, low bandwidth, and limited computation and storage capacities in each node. Design constraints are application dependent and are based on the application requirements and monitored environment. The environment plays

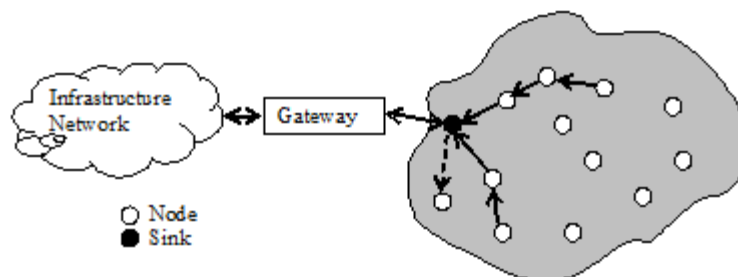
a key role in determining the size of the network, the deployment scheme, and the network topology (Yick, et al., 2008).

Selection of the optimum sensor for an application requires a good knowledge of the application and problem definition. Battery life, sensor update rates, and size are all major design considerations. Examples of low data rate sensors include temperature, humidity, and peak strain capture. Examples of high data rate sensors include strain, acceleration, and vibration.

WSNs have a great potential for many applications such as military target tracking and surveillance, industrial process monitoring and control, natural disaster relief, biomedical health monitoring, hazardous environment exploration, seismic sensing, and home automation. Although, there exist so many types of applications, event detection mechanism is recognized as an indispensable component of the most applications which facilitate the efficient sensing of the physical world using WSNs.

The rest of this chapter is organized as follows. Section 2 of the chapter provides the relevant background material covering an overview of event detection in WSNs. This overview includes event definition and classification, key issues and challenges of realizing event detection mechanism, and so forth. Section 3, which discusses threshold based detection, surveys some representative realization techniques. Section 4 covers several schemes for pattern based complex event detec-

Figure 1. Wireless sensor network



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