Chapter 1

Introduction and Overview of Wireless Sensor Networks

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ABSTRACT

Wireless sensor networks (WSNs) are becoming increasingly popular, which is changing the way people perceive the world largely, as well as the living styles of human beings. To give readers a basic, wide view of WSNs and make them understood more deeply, this chapter introduces their various aspects briefly, including basic concepts, architectures and protocols, etc. Moreover, it discusses their recent developments, challenges and new trends, based on analysis of many meaningful references. Some classic applications are also shown to approve the popularity of WSNs.

INTRODUCTION

The computer is one of the most important inventions in the 20th century. It has extended the capacities of the brain of human beings hugely during the past 50 years. Many problems that are hard or even impossible for a man’s brain have been addressed by computers in seconds. However, how the computer to get data from the real world to process is usually a key problem for scientists and engineers even today. At the early stage, programmers perforate some holes in the paper strips to let computer know what they want it to do (as the input to the computers). Later, keyboard, mouse, even touch-screen were invented to let the computer know the world. However, these tools are still passive and people-centered. People need to type or write char by char, word by word to let the computer understand the real world that they see and touch. It is still boring for most people.
Is it possible to shorten the distance between the computer and the real world and let computer see, touch and understand the real world directly and freely? This is really an attractive topic and now becoming a hot research area. WSN is one of these good answers today. It can get large numbers of data referring to temperature, moisture, smoking, movement of some objects, etc., through perceiving the real world by various sensors. With the aid of wireless networks, these data are collected and sent to some computers to be processed. So we can regard WSNs as eyes, hands, noses and nerve systems of computer world. By applying WSNs, the computer world can touch and perceive the real world everywhere, even many places where human beings have never reached because of dangers, bad weather, complexity of environments, and other reasons. They are changing the ways we explore the world greatly. More and more researchers and organizations pay their attentions to WSNs.

WHAT ARE WIRELESS SENSOR NETWORKS?

The concept of WSNs was proposed by the U.S. military as early as 1970’s. From then on, many research projects, applications and theories about WSNs have come forth. Recalling the history of the development of sensor networks, we can roughly divide it into several stages as follows (Chong, & Kumar, 2003).

In the 1970s, the emergence of some prototypes of sensor networks with traditional point-to-point transmission could be referred to as the first generation of sensor networks. In 1979, the Defense Advanced Research Projects Agency (DARPA) of USA launched the Distributed Sensor Networks Program (DSN). It was one of the representatives.

From 1980s to 1990s, processing and communications capabilities of sensor nodes were improved obviously, which made these nodes can work together by networking with each other. However, during this period, research work still mainly focused on the military field such as, SensIT plan (Sensor Information Technology), WINS (Wireless integrated network sensors) launched by DARPA. It is regarded as the second generation sensor networks.

With the continuous development of related technologies such as microelectronics, wireless communications, network transmission, from the end of the 20th century, WSNs have attracted wide attentions from academia, military and industry, which really set off a high wave of the development of WSNs technologies. Many projects have been launched and many applications have been deployed in various fields, which include military, environment monitoring, health care, intelligent home, urban transportation, space exploration, public safety monitoring, etc. Some representative projects are C4KISR Plan of DARPA, ALERT of U.S National Weather Service, SSIM program of Wayne State University, etc.

Although WSNs have affected various aspects of our work and life, different people still have different understandings about WSNs.

Concepts

Generally, WSN is regarded as an emerging technology that combines the concept of wireless network with sensors. Significant advances in microelectronics technology, computing and wireless communications reduce the energy consumption, improve the ability of communication and extend functions of WSNs continuously, which also reflect the basic characteristics of WSNs. From the following five representative statements, we can see main features of WSNs.

Karl (2003) said that WSNs “combine simple wireless communication, minimal computation facilities, and some sort of sensing of the physical environment into a new form of network that can be deeply embedded in our physical environment, fueled by the low cost and the wireless communication facilities” (p.1).