Chapter 4

Application of Computational Intelligence Techniques in Managing Wireless Sensor Networks

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ABSTRACT

This chapter gives a brief background on network management and how it is integrated into sensor network as well as the application of computational intelligence techniques in managing wireless sensor networks. Also discussed how Genetic Algorithms work in common and how they can be applied to sensor networks. Among the major management tasks rely on consumption power management, so there are many challenges associated with sensor networks but the primary challenge is energy consumption. Sensor networks are typically have little human interaction and are installed with limited battery supplies. This makes energy conservation a critical issue in deployed WSNs. All types of networks require monitoring and maintenance. A service that supplies a set of tools and applications that assist a network manager with these tasks is network management. It includes the administration of networks and all associated components. While all networks require some form of network management, different types of networks may stress certain aspects of network management. Some networks may also impose new tasks on network management. There are different types of network management architectures: centralized, hierarchical and distributed. In a centralized approach, one central server performs the role of the network management application. A hierarchical architecture will include multiple platforms, typically one server and several clients, performing network management functions.

INTRODUCTION

Network management means the process of controlling and monitoring the behavior of a network. In traditional networks the major goal is to minimize the response time, but in sensor networks the primary goal is minimizing energy use and the main means for doing this is by reducing the amount of communication between nodes. WSNs are highly dynamic and prone to faults, mainly

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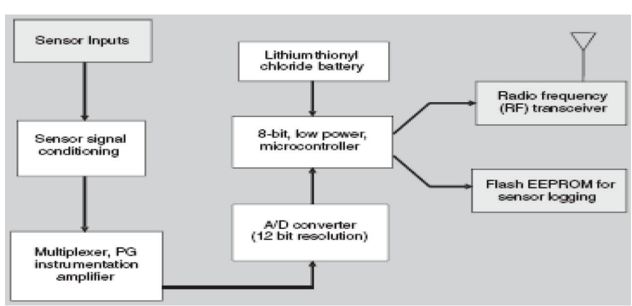
because of energy shortages, connectivity interruptions, and environmental obstacles. Network failures are common events rather than exceptional ones. Thus, in WSNs, we are mainly concerned with monitoring and controlling node communication in order to optimize the efficiency of the network, ensure the network operates properly, maintain the performance of the network, and control large numbers of nodes without human intervention. A network management system designed for WSNs should provide a set of management functions that integrate configuration, operation, administration, security, and maintenance of all elements and services of a sensor network. The ideal wireless sensor is networked and scaleable, consumes very little power, is smart and software programmable, capable of fast data acquisition, reliable and accurate over the long term, costs little to purchase and install, and requires no real maintenance. Selecting the optimum sensors and wireless communications link requires knowledge of the application and problem definition. Battery life, sensor update rates, and size are all major design considerations.

A wireless sensor network (WSN) generally consists of a base station or "gateway" that can communicate with a number of wireless sensors via a radio link. Data is collected at the wireless sensor node, compressed, and transmitted to the gateway directly or, if required, uses other wireless sensor nodes to forward data to the gateway. The transmitted data is then presented to the system by the gateway connection. A functional block diagram of a versatile wireless sensing node is provided in Figure 1. A modular design approach provides a flexible and versatile platform to address the needs of a wide variety of applications. For example, depending on the sensors to be deployed, the signal conditioning block can be re-programmed or replaced. This allows for a wide variety of different sensors to be used with the wireless sensing node. Similarly, the radio link may be swapped out as required for a given applications' wireless range requirement and the need for bidirectional communications. The use of flash memory allows the remote nodes to acquire data on command from a base station or by an event sensed by one or more inputs to the node. Furthermore, the embedded firmware can be upgraded through the wireless network in the field. The microprocessor has a number of functions including:

1. Managing the data collection of the sensors;
2. Performing power management functions;
3. Interfacing the sensor data to the physical radio layer; and
4. Managing the radio network protocol

A key feature of any wireless sensing node is to minimize the power consumed by the system. Generally, the radio subsystem requires the largest amount of power. Therefore, it is advantageous to send data over the radio network only when required. This sensor event-driven data collection

Figure 1. WSN node functional block diagram



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