Chapter 7
Wireless Data Acquisition System for Greenhouses

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ABSTRACT

This chapter presents a novel wireless data acquisition system. The system has been designed to take advantage of inexpensive robotics systems like Lego NXT, which establishes a new paradigm in the wireless ad-hoc networks field. The system architecture can record data from different variables in greenhouse environments. These wireless systems employ wireless access points (WAPs) and wireless-fidelity (Wi-Fi) adapter modules for data acquisition that sample the environment. The measurements data are transmitted to a central station or inclusive to another different node. The acquisition system was designed and adapted to be used in greenhouses located in Quintana Roo, Mexico, where the typical relevant variables are temperature, luminosity and humidity. The developed system uses virtual instrumentation to measure and record environmental variables. The proposed implementation uses commercial data acquisition boards and sensors to gather data, which are processed and visualized with the LabVIEW-based software.

DOI: 10.4018/978-1-60960-027-3.ch007

INTRODUCTION

Plants' growing in greenhouses is increasing economic activity at the Mexican state of Quintana Roo. There are greenhouses in two counties of Quintana Roo, Felipe Carrillo Puerto and José Maria Morelos. These greenhouses grow flowers and fruits for export. Figure 1 presents a public greenhouse located in José Maria Morelos county.

Greenhouses reproduce the optimal natural conditions for a given vegetal. The relevant variables in Quintana Roo are temperature, luminosity and humidity, which need to be carefully regulated. The state is located on the Caribbean coast in the Yucatan peninsula of Mexico. Consequently, it is warm, sunny and very humid during the entire year.

Vegetable production in greenhouses represents a major technological challenge because of the very specific interior climate control necessary for optimal production. Currently, foreign control technology is used in Quintana Roo's greenhouses, with the consequent technological dependence, lack of training and high cost of installation and maintenance.

The cost of mobile and sensor technologies has been decreasing. Moreover, sensing remote data is becoming easier and cheaper. The demand for customized products and services for data acquisition is high; however solutions must optimally integrate new generation sensors and technologies.

Virtual instrumentation uses software modules, instead of hardware, to control actuators or sensors. Such virtual instrumentation has many benefits: functionality, connectivity, low maintenance cost, reusability, open architecture, portability, flexibility, fast integration of new technologies, and information exchange with other applications. Furthermore, in recent years, virtual instrumentation has become very reliable. For this reason, many industries are turning to it to replace dedicated instruments.

The novel contribution of this chapter consists in the proposed architecture for a wireless data acquisition system. The system has been designed to take advantage of small and inexpensive robotics systems, Lego NXT (Gasperi, 2008), but can record variable greenhouse data. Also, we use WAP (wireless access point) and Wi-Fi adapters for data acquisition modules (Garcia et al., 2007; National Instruments, 2009). We exclusively measure environmental variables. Each module adapter node has one or more sensors attached to it. These nodes sample the environment by logging in and transmitting readings to a central station or to another node. Figure 2 shows an example of the Wi-Fi adapter and WAP.

The proposed application presented will reduce the complexity and number of sensors used to measure the environmental variables within greenhouses. Lego's NXT units, with sensors attached to them, move across the greenhouse

Figure 1. Two views of social greenhouse in Jose Maria Morelos, Quintana Roo