Chapter 2
Viticulture Zoning by an Experimental WSN

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ABSTRACT

Biological research in agriculture needs a lot of specialized electronic sensors in order to fulfill different goals, like as: climate monitoring, soil and fruit assessment, control of insects and diseases, chemical pollutants, identification and control of weeds, crop tracking, and so on. That research must be supported by consistent biological models able to simulate diverse environmental conditions, in order to predict the right human actions before risky biological damage could be irreversible. In this paper an experimental distributed network based on climatic and biological wireless sensors is described, for providing real measurements in order to validate different biological models used for viticulture applications. Firstly is introduced the rationale of zoning in Galicia’s territory. Then the experimental network for field automatic data acquisition is presented. Following, the design of the wireless network is explained in detail. Finally future developments and conclusions are stated.

INTRODUCTION

The experimental wireless network is deployed in a peninsula surrounded by two large sea arms called “rias” in Spanish language. In that peninsula, located in the northwest of Spain (near the northern border of Portugal), on the autonomous region called Galicia, the vineyards have four main productive zones called: Meaño, Cambados, Ribadumia and Meis (Figure 1).

Currently differences in productivity and quality of grapes are broadly related with relative heights and sea proximity from each of four zones but nevertheless more rigorous biological
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and climatic research (Perry, 2002; Gail, 2007) must be done, in order to provide accurate biological models for ecological simulations applied to viticulture. The relevant pests of vineyards to be detected by such models are: Botrytis Cinerea (noble rot), Plasmopara Viticola (downy mildew) and Uncinula Necator (powdery mildew). For that reason multidisciplinary work must be done among electronic engineers, biologists and ecologists.

Each zone has an electronic zonal station (EZS), in order to bring differences (microclimates), in measurements like: temperature, relative humidity, leaf humidity, soil temperature, solar radiation, rain gauge (tipping bucket), and other biological sensors. A data logger and a radio modem is included in each EZS in order to sense, process and transmit the data, enabling the development of an automatic wireless sensor network (WSN), which nodes (the EZSs) are accessible from a wide area. These wireless communication capabilities allow that data could be remotely monitored. The implementation of a warehousing approach, allows the data to be stored in a centralized database that is responsible for query processing. The stored data will be used for biological and ecological models.

This article is an extended version of reference (Mariño et al., 2008a) written by the authors. It is organized in eight parts including this introduction. Part II gives an overview about zoning in viticulture. Part III describes the Data Acquisition System. Part IV outlines the global data management. Part V provides a state-of-the-art in wireless sensor networks. Part VI details the implementation of experimental WSN. Finally, Parts VII and VIII present the future developments and conclusions.

RATIONALE ON ZONING AND PRODUCTION RESULTS

Previous work about climate and viticulture (zoning) in Galicia has been reported for a period of 1971-2000, based on data from 52 meteorological stations spread over the vineyard’s 10,000 hectares within a whole territory of 29,434 square kilometres (Queijeiro, 2006).

In the Galicia’s territory the main climatic features are (Figure I):

- Presence of wet winds from Atlantic Ocean (direction West-East)