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GREENHOUSE ENVIRONMENT MONITORING AND CONTROL: STATE OF THE ART AND CURRENT TRENDS

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Abstract

This paper reviews the recent developments and implementations for greenhouses facilities, focusing on recent progress regarding greenhouse environment monitoring and control with many available application examples. State of the art and current trends concerning the main parts of the greenhouse environment automation are discussed: i) greenhouse climate models, ii) wireless sensor networks, iii) remote monitoring/command and supervisory control and data acquisition (SCADA) systems, iv) image processing. The greenhouse engineering covers multi-disciplinary approach, engineering and economics, and for final success and sustainability, social and political support must also be achieved. Greenhouse complex nonlinear coupled climate and biological models are discussed with high importance in greenhouse optimal control solutions. Greenhouse monitoring and control applications using Wireless Sensor Networks (WSN) ZigBee modules, GPRS data transmission, and CAN bus communication are presented and classified, highlighting the communication specific benefits. Remote monitoring/command and supervisory control and data acquisition (SCADA) systems are analyzed and classified offering to users the following advantages: local and remote visualizations of process data, access to process set-points, optimal control strategies, database data recording, report generations and alarm management. Image processing is another development direction for greenhouse facilities, with promising results for insect monitoring, chlorophyll content estimation, identification, classification and harvesting of fruits. The analysis and classification in appropriate categories of recent contributions, using significant application examples referred in the paper, offers a vision for the greenhouse environment monitoring and control based on modern solutions and technologies, ideas for new applications and relevant research opportunities to optimize the greenhouse processes.

Key words: environmental engineering, greenhouse, remote monitoring and control, SCADA, wireless sensor network

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