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Application of wacnet to ambient intelligent systems

Antoine Desmet
University of Wollongong

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APPLICATION OF WACNET TO AMBIENT INTELLIGENT SYSTEMS

A thesis submitted in fulfillment of the
requirement for the award of the degree

MASTERS OF ENGINEERING - RESEARCH

from

UNIVERSITY OF WOLLONGONG

By

ANTOINE DESMET

BACHELOR OF ELECTRONICS

SCHOOL OF ELECTRICAL, COMPUTER AND
TELECOMMUNICATION ENGINEERING

2008

Certification

I, Antoine DESMET, declare that this thesis, submitted in fulfillment of the requirement for the award of Masters of Engineering by Research, in the School of Electrical, Computer and Telecommunication Engineering, university of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualification at any other academic institution.

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Antoine DESMET

October 2008

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List of Abbreviations

HTTP: HyperText Transfer protocol
CH: Cluster Head
CN: Cluster Node
Tx: Transmission
Rx: Reception
OSI: Open System Interconnection
WACnet: Wireless Ad-hoc Control NETwork
ZB: ZigBee
BT: Bluetooth
DCS: Distributed/Decentralized Control System
WiFi: Wireless Fidelity, IEEE 802.11x wireless standards
PnP: Plug and Play
HMI: Human-Machine Interface
I/O: Input/Output
TCP/IP: Transfer Control Protocol / Internet Protocol
CSMA/CD: Carrier Sense Multiple Access / Collision Detection
XML: eXtended Markup Language
JVM: java virtual machine
PCB: Printed Circuit Board
NCAP: Network capable node
XDCR Transducer
FTP: File Transfer protocol
HEX file : hexadecimal file uploaded to the microcontroller
LCD: Liquid Crystal Display
CPU: Central processing Unit

Abstract

Control Systems have gone through several stages of development over the past decades. While Fieldbus is now the established global standard for factories and plants, new areas of development are opening, requiring radically different control network architectures.

There is currently a strong demand for wireless control networks capable of meeting the application-specific requirements of military, agricultural and biological, building control, land surveying, monitoring and control networks. These new applications have characteristics which are much different from factory applications, including high autonomy and low maintenance, flexibility and adaptation in dynamic environments, extremely small size, rapid and sometimes random deployment, automatic handling of the failed nodes, etc.

With the advent of widespread, standardized and reliable wireless standards, a new generation of wireless control networks appears feasible. The concept of Wireless Ad-hoc Control Networks (WACNets) is an ongoing research project which began in 2004, at the University of Wollongong. A WACNet consists of a large number of geographically distributed intelligent and heterogeneous nodes with sensing and/or actuation, local intelligence and control, data processing and wireless communication components.

This research project pursues the technological development of the WACNet architecture and hardware, using the state of the art technologies.

The other main contribution of this work is the validation of the WACNet platform for real-life applications. A Home Ambient Intelligent system for resource consumption reduction is designed to run on a WACNet architecture.

The capacity of a WACNet to support a learning algorithm and the resulting network load is studied.

The results of the validation process demonstrate the potential of WACNets to support real-life applications, and also highlight the technical challenges which will have to be tackled before the stage of a commercially-viable product can be reached.

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