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# Application of wacnet to ambient intelligent systems

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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**

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By

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# 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

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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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