2SC6292 – Remote control of thermal comfort

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Department: DOMINANTE - GRANDS SYSTÈMES EN INTERACTION, DOMINANTE - SYSTÈMES COMMUNICANTS ET OBJETS CONNECTÉS
Language of instruction: ANGLAIS
Campus: CAMPUS DE RENNES
Workload (HEE): 40
On-site hours (HPE): 27,00

Description
This teaching aims to use the knowledge achieved through the courses of the ST "Energy intelligence and intelligent buildings" to design an automatic remote control system of thermal comfort in a multi-zone space therefore with different considerations and resources.

Prerequisites (in terms of CS courses)
- High energy-efficient communications
- Energy intelligence and smart buildings

Class components (lecture, labs, etc.)
- Teamwork (brainstorming)
- Harmonization of tasks and tools used:
    * Simulink for simulations
    * GNU-Radio for real transmission emulation
- Definition of needs and performance indicators
- preparation of deliverables

Grading
The final mark includes an evaluation of the individual contribution (work in subgroups and involvement) and a collective evaluation (deliverables, intermediate technical validations, final presentation). A penalty of - 2 pts is applied per half-day of absence.

Resources
- Teaching team for supervision: Romain Bourdais and Haïfa Farès.
- Software tools: MatLab and GNU-Radio for simulations
- Hardware tools: USRP modules for real transmissions to be configured using GNU-Radio.
- Lab rooms

Learning outcomes covered on the course

- Design a multi-zone thermal comfort regulation system that works remotely
- Introduction to Software Defined Radio
- Realization of the wireless communication between the building and the controller
- Considerations on the trade-off between the use of the wireless communication protocol and the quality of service of the control

Description of the skills acquired at the end of the course

Skills developed: C1.4, C4.2, C6.1 and C7.1.

ST5 – 63 – SMART AND EMBEDDED SYSTEMS FOR HEALTH

Dominante : GSI (Grands Systèmes en Interaction), VSE (Vivant-Santé-Environnement) et SCOC (Systèmes Communicants et Objets Connectés)
Teaching language: French with specific modalities to allow the adaptation of students with a low level in French: most course materials are in English and the integration teaching is provided in both English and French.
Campus where the course is offered: Rennes

Engineering Problem

Technological advances in terms of the measuring elements miniaturization and the control of physiological quantities allow new solutions for patient care: substitution for the control of defective organs, continuous, automated, and patient-adapted delivery of treatments. On the other hand, integrating digital communication capabilities between these control elements and connected everyday objects (smartphones, tablets, etc.) opens new opportunities for better patient involvement and doctor monitoring.
The societal stakes are apparent, both in terms of improved health and daily comfort for the patient and reduced risk of severe pathologies in the longer term.
For the engineer, the challenge is to offer a reliable integrated solution that is easy to use and adjust, low in energy consumption, and easily adaptable to a wide variety of patients.

Prerequisites

None

Context and challenges modules: This part is organized around several lectures that should give the students the keys to understand the significant issues associated with this thematic sequence. The following aspects will be addressed: the medical aspects of diabetes treatment, the problem of embedded for health, the ethical, social and human aspects through the influence of connected objects, the security of personal data, the impact of antennas.

Specific course (60 HEE,FR): *Energy-efficient communications*

- **Short description**: With a global electricity consumption of 6 to 10%, corresponding to 4% of greenhouse gas emissions, ICST (Information and Communications Sciences and Technologies) must rethink how they transmit,

process, and store data. The arrival of 5G (5th Generation mobiles) and the explosion of connected objects (Internet of Things) suggest that the sector will continue to grow very strongly in the next years, making it more urgent to offer more environment-respectful communications. Spectral efficiency requirements (transmitting a rate within a given bandwidth) must then be combined with an intense energy efficiency constraint (transmitting while consuming as little as possible). This course provides training in digital communication concepts and tools for which energy efficiency is explicitly taken into account.

Specific course (60 HEE,EN): *System Architecure and Modeling*

- **Short description:** Modern systems are becoming more and more complex. This complexity results from the interaction between their components, the increase and complexity of the exchanged data, the heterogeneity of concepts, substances, trades, standards, but also from human complexity (organization,ergonomics, psychology, sociology ...). To better handle this complexity, it is often necessary to model the different artifacts of the system. This modeling allows stakeholders at different phases of the system's life to better understand its objectives, to structure its architecture, to make analyses to predict its behavior, and thus to make a justified choice between alternatives. The various models constitute a reference for all stakeholders involved in the system design. Thus, the objective of this course is to provide students techniques and tools for modeling and structuring system architectures. Technological systems will be privileged with fields such as avionics, railway, industry, energy, or health. Moreover, the emphasis will be made in identifying system performance attributes (critical SPI system performance indicators) that need to be monitored to design, implement, operate, or manage complex systems.

Integration teaching: *Smart system for personalized blood glucose control*

- **Associated partner**: CHU Rennes – Diabetology Department.
- **Location:** Campus of Rennes
- **Short description:** The objective is to propose a system to help regulate blood sugar levels for diabetic patients. This system must respond to various issues: operational safety and comfort of use for the patient, digital integration of control algorithms, ability to interact with control elements (subcutaneous blood glucose sensor, micro-pump for insulin delivery, ...) via various communication protocols and low energy cost. It must allow local interaction with the patient and remote interaction with a doctor to monitor biomedical data.