

IDENTIFICATION

Course code : ESI-SPI-CI-IN4-S8-UE2-EC1
ECTS : 1

DURATION

Lectures : 0
Tutorial classes : 12
Labs : 0
Total : 12

Project :
Personnal work :

ASSESSMENT

Continuous assessment : written exams, oral presentations, case studies.

TEACHING MATERIALS

Slides, industrial case studies, field experience feedback.

LANGUAGE

English

CONTACT

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UE : UE8-IOT

COURSE : Internet of Things : Design Project

SCOPE OF THE COURSE

OBJECTIVES

Provide engineering students with the methodology and tools needed to carry out an IoT project from specifications to a deployable prototype. This course combines methodological input (lectures), case studies and sizing (tutorials), and hands-on practice through a complete design project.

COMPETENCE AND SKILLS

- Apply embedded and IoT-specific programming and communication paradigms
- Evaluate a project's cost and the economic viability of a solution
- Assess the environmental impact of a solution
- Manage a project while respecting cost, schedule, and quality constraints

PROGRAM

— Lecture — IoT Design Methodology (4h)

- IoT product design cycle : ideation, specification, prototyping, validation, industrialization
- End-to-end system architecture : sensor node, gateway, network, cloud/edge platform, application
- Architecture choices : edge vs. fog vs. cloud — decision criteria (latency, bandwidth, autonomy, cost)
- From breadboard to PCB : hardware design principles for production (component selection, BOM, DFM)
- Regulations and certification : CE marking, RED/RoHS/WEEE directives, ISM bands, radio approval
- Security by design : secure boot, secure OTA, key management, threat modeling (STRIDE, PASTA)
- Scaling up : fleet management, provisioning, monitoring, remote updates (FOTA/SOTA)
- Eco-design : life cycle assessment (LCA), digital sobriety, cost estimation (BOM, NRE, TCO)

— Tutorials — Case studies and sizing (12h)

- Tutorial 1 (3h) : Architecture analysis — Dissect a commercial IoT product : identify hardware and software components, evaluate technical choices and trade-offs
- Tutorial 2 (3h) : Energy budget — Size the power supply for a sensor node (consumption profile, duty cycle, energy harvesting), estimate autonomy, and propose optimizations
- Tutorial 3 (3h) : Robustness and security — Conduct a threat model (STRIDE, PASTA) on an IoT architecture, define countermeasures (secure boot, encryption, OTA), assess field robustness (IP, temperature, MTBF)

- Tutorial 4 (3h) : Costing and eco-design — Build a BOM, estimate unit cost and TCO at different scales, perform a simplified life cycle assessment (LCA), justify component choices
- **Design Project (20h + 10h self-study)**
 - In teams of 3-4 students, carry out a complete IoT design project on a given or proposed topic
 - Expected deliverables :
 - Functional and technical specifications
 - Architecture report (system diagram, justified hardware/software choices)
 - Energy budget and autonomy estimation
 - Security analysis (threat model) and mitigation plan
 - Costing (BOM, unit cost, TCO) and eco-design analysis
 - Functional prototype (proof of concept)
 - Project presentation

BIBLIOGRAPHY

Olivier Hersent, David Boswarthick, Omar Elloumi — *The Internet of Things : Key Applications and Protocols* — Wiley, 2012
Jan Holler et al. — *From Machine-to-Machine to the Internet of Things* — Academic Press, 2014
Perry Lea — *IoT and Edge Computing for Architects* — Packt, 2020
Espressif Documentation — *ESP-IDF Programming Guide* — docs.espressif.com

REQUIREMENTS

- IOT701 : Embedded and Real-Time Systems
- IOT706 : Data Analysis for IoT
- IOT601 : Prototyping (S6)