School of Technology and Management
Course Unit Syllabus

Level of qualification:
Second Cycle (EQF level 7) - Master
Study cycle:
The Internet of Things

Course Unit: – **Systems Integration**

Year 1 **Semester 2** **ISCED Code: 0714** **ECTS: 6**

Type of Course Unit: Compulsory **Delivery Mode:** Face-to-face / Distance Learning **Language of Instruction:** Portuguese

COURSE COORDINATOR: José Jasnau Caeiro / João Carlos Martins

HOURS OF WORK

TOTAL HOURS	**Contact Hours**								**Hours in autonomous work**
	Theory	Theory and practice	Practical and laboratory work	Field work	Seminar	Internship	Tutorial guidance	Other	
150		**29**							**121**

Prerequisites (if applicable): n.a.

LEARNING OUTCOMES (knowledge, skills and competence)

1. Describe the systems integration paradigm importance in IoT.
2. Identify the different hardware subsystems and software in IoT systems.
3. Know the main computing platforms used in IoT.
4. Build a system for IoT based on the integration of several hardware and software subsystems.
5. Use different software packages (operating system, web-frameworks, programming tools) to develop a solution for IoT following the client-server paradigm.
6. Apply the most common signal processing operations for signal, image processing, video and audio.
7. Design a system for IoT with the client-server paradigm, with remote client modules and M2M communications through systems integration.

CONTENTS

1. Low-cost computing platforms: ESP32 and Raspberry Pi.
2. The Linux operating system on embedded systems: installation and development tools.
3. Access, use and programming of hardware interfaces.
4. Development of applications with access to interfaces and cross-compilation
5. Physical connection to sensors and actuators.
6. Use of platforms such as Web Servers and Web clients.
7. Image, audio and video acquisition and processing.
8. M2M communication between computer systems.

DEMONSTRATION OF THE CONTENTS COHERENCE WITH THE COURSE UNIT'S LEARNING OUTCOMES

We specify the relevant contents for each learning outcome:

1. Understand the importance of systems integration paradigm in IoT. (1)
2. Identify the different hardware and software subsystems in an IoT system. (1, 2, and 4)

3. Know the main low-cost computing platforms used in IoT. (1)

4. Build a system for IoT based on the integration of several hardware and software subsystems. (1, 2, 3, 4, and 5)

5. Use the different software packages (operating system, web-frameworks, programming tools) to developing a solution for IoT with the client-server paradigm. (1, 4, 5, and 6)

6. Apply the most common signal processing operations for signal, image processing, video and audio. (1, 4, and 7)

7. Design a system for IoT with the client-server paradigm, with remote client modules and M2M communications through systems integration. (1-8)

TEACHING METHODOLOGIES

The syllabus will be presented using practical examples and analysis of current computational platforms and systems used in the IoT. Students are asked to make a critical analysis of an existing system, either based on a concrete real system or on a system described in the literature, analyzing both their hardware and software. Afterwards, the students will be introduced to the most common software development systems and programming tools to support systems in production for IoT. The most common signal processing techniques will also be implemented and applied by students for processing data collected by remote modules, and for audio and image processing. At the end, the students will design and develop a system for IoT from the integration of several systems.

DEMONSTRATION OF THE COHERENCE BETWEEN THE TEACHING METHODOLOGIES AND THE LEARNING OUTCOMES

It is intended that the student knows the main computer systems used in the development for IoT systems, which can be used both as client and server. Several real computational platforms will be studied, namely Raspberry Pi and ESP32 platforms. Students are expected to know these systems, in terms of both hardware and software, and be able to develop software applications using its hardware interfaces. The students will also implement in software the most common signal processing operations, and more specifically, processing of audio, video and other signals. It is understood that learning is more effective when practical cases are used with the development and implementation of applications in real situations. Thus, the practical component of the course is particularly important so that, in the end, students can apply the systems in solving a particular problem in IoT.

EVALUATION METHODS

The students evaluation is composed by two components:

1. Practical laboratories;

3. Design and development of an IoT system using the system integration paradigm, with project demonstration and report discussion .

MAIN BIBLIOGRAPHY

- Eben Upton , Gareth Halfacree , Raspberry Pi User Guide, 4th Edition, John Wiley & Sons, 2016.

- Derek Molloy, Exploring Raspberry Pi: Interfacing to the Real World with Embedded Linux, John Wiley & Sons, 2016.

- Donald Norris, The Internet of Things: Do-it-yourself at Home Projects for Arduino, Raspberry Pi, and BeagleBone Black, McGraw-Hill, 2015.

- Donald Norris, Machine Learning with the Raspberry Pi: Experiments with Data and Computer Vision, Apress 2019.

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