INTEGRATED LABORATORIES I

Mestrado em Engenharia Eletrónica e de Computadores

Code: 26801

Main Scientific Area: Intelligent Systems and Control

Lecturer: António Herculano de Jesus Moreira

Language of Instruction: Portuguese

Regime: S1

Contact Hours: 30h Total Workload: 138h

ECTS: 6,0

Objectives

This course aims to endow the students with technical knowledge on embedded systems developing that uses an embedded Linux based OS. The development is performed through C/C++ programming language and Linux system calls to access peripheral devices. The hardware development is based on devices that are connected to an SoC (System on Chip) through several serial communication interfaces. It is also intended to address the parameterization and compilation of embedded applications in Qt 5 for an operating system based on the Linux kernel.

Learning Outcomes

The students should be capable of connecting several peripheral devices, such as sensors to an SoC (System on Chip) through different serial communication interfaces like I2C, SPI or UART. The students should also be capable of using GPIOs of the SoC. The interface with the peripheral devices is made through Linux system calls like ioctl, open, close, write and read. The students should be skilled in the development of Qt5 applications with multithreading and server capabilities based on Linux TCP/IP sockets to provide access to the embedded system through other devices.

Course Contents

1. Development of an application for an embedded Linux-based hardware platform

a. Configuration and compilation for Linux in an ARM architecture

i. Qt Embedded Platform

c. Development platform configuration

i. IDE, cross-compile, remote debug

d. Software modeling and object-oriented programming (C ++ language)

i. Qt 5-based user interface

ii. Use of Threads / Sockets for TCP / IP communication

d. Communication with peripheral devices to the system

i. Access to hardware through an operating system (Debian)

e. Communication protocol implementation

i. USART / USB

ii. I2C / SPI

2. Interconnection of a client application to the Android platform with IoT connection

a. User Interface for communication/monitoring with the embedded system

b. Connection to sensors and external hardware

c. Implementation of a communication protocol with IoT platforms (MQTT).

Recommended Bibliography

Simon, David. 2005. An Embedded Software Primer. Pearson Education.

Hallinan, Cristopher. 2006. Embedded Linux Primer: A Practical, Real-World Approach. Prentice Hall.

Greg Kroah-Hartman. 2006. Linux Kernel in a Nutshell. O'Reilly.Jonathan Corbet, Alessandro Rubini and Greg Kroah-Hartman. 2005. Linux Device Drivers. O'Reilly

Learning and Teaching Methods

The curricular unit syllabus is strongly related with the goals. The sequence of the topics follows the sequence of project development based on the embedded platform. The topics are, in a first stage, exhibited in a theoretical basis. Later, the contents exhibited are applied in the context of the practical work.

Assessment Methods

The assessment is of a practical nature, in two dimensions, A - individual (50%, minimum mark of 8) and A - group work (50%, minimum mark of 10). Students carry out practical laboratory work in groups on a topic defined in class, always based on an embedded system.

In the practical laboratory aspect, continuous assessment is based on the preparation of each phase of the work, the development of the project over time and its individual defense. On the individual side, there is an oral assessment on topics related to the practical laboratory work. Concrete problems are posed which allow the student to demonstrate the knowledge demonstrated in the practical laboratory work.