﻿Real-time Hardware Project

*Embedded system*

Author: your surname, your name

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Semester: 24HT

Course code: 1DT903

Assignment 2

# Deadline:

The deadline to submit the assignment is **10 Oct 2024**.

# Assignment structure:

# This assignment will teach you how to perform multithreading using dual-core programming on Raspberry Pi Pico

# Rules:

1. You have to submit a report for assignment, with the LNU template.
2. You have to submit a file, either in *.docx* or *.pdf* format.
3. You are allowed to use this file to make you report, or you can use a new one. In the case you use a new file, make sure to refer to the exercises you are answering. In the case of a new file, you still have to use the LNU template.
4. The file you submit **must be renamed** as follows: <1DT903\_surname\_name\_assignment2 >.
5. Deadline is **10 Oct 2024**. Each day of delay over the submission deadline will cause a penalization of 5 points on the global score of this assignment.
6. In the case photos are inserted into the report, if the **scans/photos** relative to an exercise **are not readable**, **no points will be given to that exercise**.

# **Exercise 1** (10 pts)

The circuit shown in below is an amplifier, amplifying input voltage

Vin: Vout = gclosed ∗ Vin

Compute the gain gclosed for the below circuit, as a function of R1,R2,R3,R4,R5 and R6!

A picture containing text, clock

Description automatically generated

**Exercise 2** (10 pts)

Develop the schematic of a 3-bit DAC! The conversion should be done for a 3-bit vector x encoding positive numbers. Prove that the output voltage is proportional to the value represented by the input vector x.

# **Exercise 3** (30 pts)

﻿Real-time Hardware Project

In this assignment, you will develop a real-time hardware project that demonstrates the necessity of using an RTOS, as MicroPython alone cannot meet the real-time requirements. Your project must include a sensor, a button, an LED or buzzer, wireless communication with a remote device, and real-time constraints that require the use of an RTOS on the Raspberry Pi Pico. You will show the limitations of MicroPython/CircuitPython by implementing the project using a basic program that fails to meet the real-time requirements.

Steps:

* ﻿Use RPi Pico 2040 as the microcontroller.
* ﻿Implement a real-time hardware project with at least one sensor, one button, wireless communication with a remote device and an LED or buzzer
* Implement a wireless communication protocol (such as WiFi) to transmit the processed data to a simple user interface (such as a web page) to display the processed data.
* ﻿Perform the test by the MicroPython/CircuitPython implementation
* ﻿Perform the test with the RTOS-based implementation and the Compare the results to demonstrate the necessity of using an RTOS to fulfill the real-time requirements of the project (optional)

**# Report**

* **﻿**Describe the project, including the hardware components and their functions.
* Explain the real-time requirements and why an RTOS is necessary.
* Detail the implementation process for MicroPython/CircuitPython versions of the project

**​# Evaluation Criteria**

* ﻿Project complexity and creativity.
* Fulfillment of real-time requirements.
* Quality of the test protocol and its ability to demonstrate the necessity of an RTOS.
* Thoroughness of the report, including clear explanations and supporting evidence.

**​# Notes**

- This assignment is designed for group work (max 2 person).