Linnæus University
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Assignment 1

ADC of Raspberry Pi Pico

Embedded system

Author: your surname, your name
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Semester: 24HT
Course code: 2DT903

Deadline:

The deadline to submit the assignment is **25 Sep 2024**.

Assignment structure:

In this assignment, you will learn to use ADC of Raspberry Pi Pico using Micro-Python.

Rules:

1) You have to submit a report for assignment, with the LNU template.
2) You have to submit a file, *in 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: <2DT903_surname_name_assignment1 >.
5) Deadline is **25 Sep 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 (5 pts)

Assume that we have an input signal x consisting of the sum of sine waves of 1.75, 2 and 3 kHz. We are sampling x at a rate of 5 kHz. Will we be able to reconstruct the original signal after discretization of time? Please explain your result!

Exercise 2 (10 pts)

Suppose that we are working with a successive approximation-based 4-bit ADC. The input voltage range extends from Vmin =0.5 V (="0000") to Vmax =5 V (="1111"). Which steps are used to convert voltages of 1.8, 2.3, 3 and 3.8 V? Draw a diagram similar to Lecture Seventh, Slide 30, which depicts the successive approximation to these voltages!

Exercise 3 (35 pts)

Raspberry Pi Pico ADC with Voltage Measurement Examples

This exercise will guide you through the process of reading analog values using the Analog to Digital Converter module of Raspberry Pi Pico with Thonny IDE and UpyCraft IDE. To interface with the ADC channel and provide an analog signal, you will connect a potentiometer to the Raspberry Pi Pico board and read its analog values and show the voltage values and integer (digital) values of the input analog signal in the Display Module.

Required Components:

Raspberry Pi Pico

Potentiometer

OLED Display Module

Connecting Wire

Prerequisites:

Prior to beginning this assignment, ensure that you have the latest version of Python3 installed on your system and have set up Micro-Python on your Raspberry Pi Pico. Additionally, you should have an Integrated Development Environment (IDE) installed and running to perform the programming tasks.

-First, calculate the sampling frequency for the ADC on the RP2040 microcontroller (Note: RP2040 microcontroller operates on 48MHZ clock frequency which comes from USB PLL. ADC takes 96 CPU clock cycles to perform one conversion):

-Second, calculate Raspberry Pi ADC Resolution (In Raspberry Pi Pico, there is a 12-bit SAR type ADC):

-Third, display the voltage values and integer (digital) values of the input analog signal: Here write, an example code in MicroPython to read the values of the potentiometer which varies the analog input voltage by converting them into integer (digital) values and the voltage values, and displaying on OLED Display Module.

Report

- - Describe the project, including the hardware components and their functions.
- - Detail the implementation process
- - Explain the test protocol and the results obtained from both implementations.

Evaluation Criteria

- Thoroughness of the report, including clear explanations and supporting evidence.

Notes

- This assignment is designed for individual work.