Lab 1: Understand the system

Learning objective:  (i) Extract the workload model and scheduling algorithm from the code using your knowledge from the real-time system’s course, (ii) explain how the tasks are scheduled, and (iii) measure the overheads.

Assessment instructions: The grade is on a scale from 0-10. You will pass this assignment only if you gain at least 6 points.

Preparation: A package of source files will be available for this assignment. Study the distributed code.¹

Main questions

Answer the following questions in a digital format and upload it into BrightSpace. Please do not forget to add your names, student numbers, and the date of submission to the file you upload.

1. (0.5 points) What are the parameters (period and execution time) of each task? Report these parameters in the following units: clock ticks and milliseconds (1 % precision).

2. (1.5 points) Explain how, when, and where (in which files, functions, and lines) the code releases a new job of a task? Notes: your answer should not be more than 200 words. You can include figures/tables to justify your answer.

3. (1.5 points) Explain how does the scheduler work. Your answer must include the following information: when and where (in the code) the scheduler is called? How does it select the next task to schedule? What scheduling policy is used in this system? Notes: your answer should not be more than 200 words. You can include figures/tables to justify your answer.

4. (2 points) How much time is spent on executing system functionalities (e.g., context switch function, scheduling function, timer interrupt handler, etc.) instead of executing the actual tasks within one hyperperiod? (Briefly justify your answer using plots or tables that show the overheads). Note: do not include the initialization phase (i.e., start counting from time first interrupt flank at 3.45ms). Hint: intr_num displays this overhead.

5. (0.5 points) What is the average system overhead per unit of time (or per clock tick)? System overhead is the same as the overhead mentioned in the previous question. Hint: calculate the time that was not spent on executing actual tasks for one hyperperiod (start after the initialization phase) and divide it by the length of the hyperperiod.

6. (4 points) How does the overhead change with the increase in the number of tasks in the system? To answer this question, draw a plot whose horizontal axis is the number of tasks (e.g., 1, 2, 3, 4, 5, 6, 7, 8, 9, 10) tasks) and its vertical axis is the average system overhead per unit of time (i.e., total system overhead per hyperperiod divided by the length of the hyperperiod as you have calculated in Question 5). To get the plot, you can simply increase the number of maximum tasks in the systems. This is defined by the NUMTASKS global variable defined in Scheduler.h.

¹The MSP430x4xx User’s Guide can be found at http://www.win.tue.nl/san/education/2IN26/MSP430%20-%20general.pdf