Embedded Real-Time Systems - 2022/2023

FEUP - M.EIC027

Topics for seminars

1. Moon landing of Apollo 11 (the moon landing problem and priority assignments)
   - http://www.hq.nasa.gov/office/pao/History/SP-350/ch-11-4.html
   - http://klabs.org/history/apollo_11_alarms/eyles_2004/eyles_2004.htm

2. Mars Pathfinder (priority inversion problem when scheduling the instrumentation bus)
   - https://www.cs.unc.edu/~anderson/teach/comp790/papers/mars_pathfinder_long_version.html

3. Prototyping an Onboard Scheduler for the Mars 2020 Rover (embedded computer architecture and scheduling options)
   - https://ai.jpl.nasa.gov/public/documents/papers/rabideau_iwpss2017_prototyping.pdf

4. SCHED_DEADLINE in Linux, and its features
   (Basic algorithm, Multi-processor version, experiments and results, ...)
   - https://www.youtube.com/watch?v=wzrcWNIneWY
   - https://www.kernel.org/doc/Documentation/scheduler/sched-deadline.txt

5. Boot sequence of embedded Linux in a PC (explain)
   UEFI --> bootloader --> kernel --> OS --> OS services
   - https://en.wikipedia.org/wiki/Unified_Extensible_Firmware_Interface
   - https://www.quora.com/How-does-the-Linux-boot-process-work

6. Compare tickless versus tick-based kernels
   - https://www.quora.com/What-is-a-tickless-kernel
   - http://www.freertos.org/low-power-tickless-rtos.html
   - http://stackoverflow.com/questions/24105287/what-is-meant-by-real-time-operating-system-tick-time-and-what-is-the-use-of-this

7. Linux tickless operation (explain)
   - http://www.cs.columbia.edu/~nahum/w6998/papers/ols2007v2-tickless.pdf
   - http://elinux.org/Kernel_Timer_Systems
   - http://elinux.org/High_Resolution_Timers

8. Metrics and benchmarks for RTOS
   - https://www.embedded.com/measure-your-rtoss-real-time-performance/
   - http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6021563&tag=1

9. Implementation concerns related to priority inheritance
   - https://www.embedded.com/how-to-use-priority-inheritance/
     Search for “Against Priority Inheritance”
   - http://www.math.unipd.it/~tullio/SCD/2007/Materiale/Locke.pdf

10. Applying Android OS to real-time applications
    - https://www.researchgate.net/publication/236952843_Android_and_Real-Time_Applications_Take_Care

11. RT_PREMPT, bringing real-time to Linux (explain)
    - https://www.researchgate.net/publication/331290349_The_real-time_linux_kernel_A_survey_on_Preempt_RT

12. WCET determination (and CPU architectures)
    - https://www.timing-validation.com/wcet/
    - https://pdfs.semanticscholar.org/5c61/6f61e8c9f79453dfdad3cdc9300151ef0e43.pdf

13. AUTOSAR architecture and real-time properties
    - https://www.autosar.org/
    - https://www.automotive-iq.com/electrics-electronics/whitepapers/introduction-autosar-coding-guidelines

14. General description of eCOS
    - http://www.ecoscentric.com/news/press-170314.shtml

15. General description of QNX Neutrino RTOS
    - https://pt.slideshare.net/raziel_lucagbo/qnx-os
    - http://www.qnx.com/developers/docs/6.5.0/index.jsp?topic=%2Fcom.qnx.doc.neutrino_user_guide%2Fos_intro.html

16. General description of VxWorks RTOS
    - https://resources.windriver.com/vxworks-introductory-video-tour
    - https://resources.windriver.com/articles/engineer-complex-connected-systems-for-safety-security-and-reliability-2

17. General description of FreeRTOS
    - https://www.freertos.org/about-RTOS.html

Alternatively, you can choose a topic from the lectures and complement it with material beyond the slides used in the lectures. For example:

- Another Real-Time Operating Systems
  (RIOT, PikeOS, Zephyr OS, Huawei LiteOS, embOS, Azure RTOS, ...)
- Memory models and their usage in embedded systems
- Cross-compilation process for embedded systems
- Static scheduling with cyclic tables
- Scheduling sporadic tasks
- Synchronization mechanisms to access shared resoures
- Handling aperiodic tasks
- Programming embedded systems with real-time Posix
- Programming critical embedded systems

Assessment/Grading items

- Technical accuracy (orally and on the slides) (8 points)
- Trafe-off between technical depth and coverage of the topic (4 points)
- Slide Layout (the simpler the better) (3 points)
- Oral flow (fluidity and organization of ideas) (3 points)
- Timeliness (2 points)