ETH
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Swiss Federal Institute of Technology Zurich

TIK
Institut für Technische Informatik
und Kommunikationsnetze
Computer Engineering and
Networks Laboratory

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Semester/Master Thesis:

Orchestrate the Mixed-Criticality Melody

Reconcile Energy with Safety

The Background: Mixed-Criticality is emerging as a significant trend for future computer systems, e.g. automotive, avionics, medical and cloud systems. For such systems, applications of different safety/security criticality levels share a common commercial-off-the-shelf computing platform, to meet increased performance demand and to reduce system cost. The ultimate design goal for mixed-criticality systems is to provide different levels of assurance to applications of different criticality levels, while the main difficulty is that resource sharing could lead to mutual interferences among critical and non-critical applications, jeopardying safety/security guarantees.

In the meanwhile, low power (energy efficiency) is a prominent issue for electronic systems. The reason is multi-fold, e.g.: 1) to reduce energy cost (e.g. for high-end vehicle computers, there can be more than 100 electronic control units (ECUs), which requires a tremendous power supply); 2) to increase battery life (many embedded computer systems like medical devices or smart sensors are battery operated, energy efficiency could directly increase the battery life and reduce maintenance costs). Common techniques to conserve energy includes dynamic voltage and frequency scaling (processor voltage and frequency can be reduced at runtime to reduce energy dissipation) and dynamic power management (processor can be put into a dormant mode or switched off when idle to save energy).

The Thesis: In our group, we have developed the first results on applying dynamic voltage and frequency scaling to mixed-criticality systems, where energy can be significantly reduced while considering system safety and mutual interferences among different criticality levels [1]. We have further designed new algorithms that could potentially dominate existing algorithms on a single core. The tasks of this thesis are as follows:

- Implement and evaluate the new algorithms. In addition, you will theoretically investigate the new algorithms and compare them with existing approaches.
- Implement and compare several task mapping algorithms that map tasks to different cores on a multicore processor. In particular, you will investigate their energy saving capabilities, and you could further improve the suggested mapping algorithms.
- Conduct extensive experiments and thoroughly investigate all proposed algorithms.

What you will get? You will get yourself familiar with the next generation mixed-criticality systems, cutting-edge research on real-time scheduling, and important techniques for energy conservation in electronic systems. You will get a chance to develop both analytical and implementation skills.

Requirements:
Courses: Embedded System
Programming: C/C++ Java Matlab/Mathematica

Interested? Please have a look at http://www.tec.ethz.ch/research.html and contact us for more details!

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References

[1] P. Huang, P. Kumar, G. Giannopoulou, and L. Thiele. Energy efficient dvfs scheduling for mixed-criticality systems. In *Proceedings of the 14th International Conference on Embedded Software*, EMSOFT '14, pages 11:1–11:10, New York, NY, USA, 2014. ACM.