

Real-Time Scheduling algorithms and battery consumption for mobile devices

David Sánchez Albán
Ingeniería en Computación
Instituto Tecnológico de Costa Rica
San Jose, Costa Rica

Natalia Marín Pérez
Ingeniería en Computación
Instituto Tecnológico de Costa Rica
San Jose, Costa Rica

Luis Diego Chavarría Ledezma
Ingeniería en Computación
Instituto Tecnológico de Costa Rica
San Jose, Costa Rica

Abstract—With the explosive growth of the mobile devices in the last years, the life of the battery is more important than ever. It has become so important in mobile devices that it is now a challenge for the manufacturers since it is a prominent feature on the market. Besides the improvements on hardware, it has evolved at the software level to even be included as another of the main assets that the OS has to manage along with the CPU, memory, IO and information storage. [1]

In this paper we explore different algorithms for real time scheduling and how they can impact, in a good or a bad way, the energy consumption and the battery's life.

The University of Michigan created a paper on Real-Time Dynamic Voltage Scaling [4] for embedded operating systems that takes care of applying algorithms capable of modifying the OS's real-time scheduler and task management service by doing so this helps to save energy greatly. There have been also a great advancement in the Real Time Scheduling algorithms, the Zhejiang University [2] developed an algorithm which improves the efficiency of the embedded systems and also the Federal do Rio Grande University tuned the CPU configuration [3] in a way that it could consume less power without missing any deadline. We will be investigating new algorithms by analyzing the data obtained with the Trepan Plug-in for Eclipse which helps to get data about how a mobile app uses CPU, network and hardware resources.

- [7] S. Alsalihi, W. Akl and H. Hassancin, "Energy-aware task scheduling: towards enabling mobile computing over manets," *Parallel and Distributed Processing Symposium*, April 2005. [Online]. Available: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=arnumber=1420171>
- [8] J. Wei, R. Ren, E. Juarez, and F. Pescador, "A linux implementation of the energy-based fair queuing scheduling algorithm for battery-limited mobile systems," *IEEE Transactions on Consumer Electronics*, pp. 267 – 275, May 2014. [Online]. Available: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=arnumber=6852003>
- [9] S. Padmanabhan Ray, P. Dasgupta, and P. Chakrabarti, "Formal verification of power scheduling policies for battery powered mobile systems," *Annual IEEE India Conference*, pp. 1 – 6, September 2006. [Online]. Available: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=arnumber=4086301>
- [10] F. Wu, E. Agu, and C. Lindsay, "Adaptive cpu scheduling to conserve energy in real-time mobile graphics applications," *International Symposium of Advances in Visual Computing*, pp. 624–633, December 2008. [Online]. Available:

REFERENCES

- [1] A. Turing, "Computing machinery and intelligence," *Mind*, 1950. [Online]. Available: <http://www.csee.umbc.edu/courses/471/papers/turing.pdf>
- [2] P. Pillai and K. G. Shin, "Real-time dynamic voltage scaling for low-power embedded operating systems," *ACM symposium on Operating systems principles*, pp. 89 – 102, December 2001. [Online]. Available: <http://dl.acm.org/citation.cfm?id=502044>
- [3] M.-H. Cho, J.-S. Lim, and C.-H. Lee, "ertos : The low-power real-time operating system for wearable computers," *IEEE Transactions on Consumer Electronics*, pp. 1015 – 1019, May 2009. [Online]. Available: <http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=5156939>
- [4] L. Becker, M. Wehrmeister, and C. Pereira, "Power and performance tuning in the synthesis of real-time scheduling algorithms for embedded applications," *Integrated Circuits and Systems Design*, pp. 169 – 174, September 2004. [Online]. Available: <http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=1360564>
- [5] S. Sindia, A. S. G. Lim, V. Agrawal, B. Black, and P. Agrawal, "Mobsched: Customizable scheduler for mobile cloud computing," *45th Southeastern Symposium on System Theory*, pp. 129 – 134, March 2013. [Online]. Available: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=arnumber=6524965>
- [6] A. Nir, M.; Matrawy and M. St-Hilaire, "An energy optimizing scheduler for mobile cloud computing environments," *Computer Communications Workshops*, pp. 404 – 409, April 2014. [Online]. Available: <http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=arnumber=6849266>