Energy Conservation for QoS-Aware Real-Time Embedded Systems Under Fault-Tolerance Requirements

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Abstract:
Quality of service (QoS), energy conservation, and fault tolerance are among the essential design issues of real-time embedded systems. In this work, we focus on exploring methods that can simultaneously address the above three critical design aspects using standby-sparing. The standby-sparing mechanism adopts a dual-processor architecture in which each processor plays the role of the backup for the other one dynamically. In this way it can provide fault tolerance subject to both permanent and transient faults. Due to its duplicate executions of the real-time jobs/tasks, the energy consumption of a standby-sparing system could be quite high. With the purpose of reducing energy under standby-sparing, we proposed a novel scheduling schemes for real-time embedded systems with QoS constraints in terms of (m, k)-constraint, which require that among any k consecutive jobs of a task at least m out of them must meet their deadlines. Through extensive evaluations and performance analysis, our results demonstrate that the proposed techniques significantly outperform the existing research in energy conservation while assuring (m,k)-constraints and fault tolerance under standby-sparing.

Keywords:
Real-time embedded systems, Quality of Servis, fault tolerance, energy conservation, standby-sparing.