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Hardware assisted Real-Time Resource Management for Multi-Core MCU Architectures

Abstract

Today's embedded systems see a strong technology shift from single-core to multi-core controllers. While this opens new possibilities regarding the computational load and the integration density of modular applications, their composition and increasing complexity also raises new challenges: Isolation, interaction, and the dynamic management of globally shared resources under hard real-time conditions are just a few examples. As a leftover from classical single-core (operating) systems, well-established task schedulers were extended to several cores or operate them independently with fixed resource assignments. In our opinion, existing protocols for static or dynamic resource management do neither exploit the full potential of modern multi-core MCUs, nor do they fulfill the changing real-time requirements of today's mixed-criticality applications – especially when operating in highly dynamic environments and under strict dependability demands. In this work, we present a novel resource management technique for compositional software running on multiple cores. Implemented both in hardware and in software at operating systems level, our approach features a collaborative programming paradigm for sharing exclusive resources on-demand and with guaranteed allocation delays between independently developed tasks and across cores.