INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: New Approaches to Energy and Temperature Aware Scheduling Techniques for Real-time Multi-core Systems

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SHORT ABSTRACT

A system is classified as real-time if it is characterized by a dual notion of correctness: logical as well as temporal. Proportional fair schedulers are often preferred in such real-time systems due to their inherent advantages such as the ability to provide temporal isolation to a task in the face of possible anomalous behaviour of other tasks, high resource utilization, seamless handling of dynamic task arrivals etc. Many real-time systems in devices like mobiles, laptops, PDAs, etc., depend upon battery as their primary source of energy. Therefore, efficient usage and management of energy while satisfying all temporal and resource constraints, has become a design parameter of paramount importance, in these devices. At the system level, two important strategies namely Dynamic Voltage/Frequency Scaling (DVFS) and Dynamic Power Management (DPM) are used to manage energy consumption. DVFS involves dynamic adaptation of a processor's operating voltage/frequency according to instantaneous requirements of the workload being handled at a given time. DPM on the other hand involves suspending parts of a system when processors are idling (due to low workloads), because energy consumed during the suspension period is negligible. Over the years, the industry is witnessing a significant shift in the nature of processing platforms in real-time embedded systems. The need to satisfy stringent performance requirements, often along with additional constraints on size, weight, power etc., has ushered in the era of heterogeneous processing platforms in today's complex embedded control systems. This research work has delved towards the design of both DVFS and DVFS-cum-DPM based real-time scheduling strategies for homogeneous as well as heterogeneous multi-core platforms. Apart from energy, temperature also often plays a critical role in the efficient performance of many real-time and embedded devices prevalent today. Uncontrolled rise in temperature beyond a safe threshold limit not only increases cooling costs, but may also reduce a system's efficiency and life span. Some of the techniques used to reduce temperature at the system level includes workload balancing, frequency scaling, core suspension etc. This thesis has also concentrated on the design of temperature-aware scheduling techniques which attempts to maximize resource utilization while ensuring that temporal as well as thermal constraints related to the system are satisfied. We have not only used benchmark programs to test our proposed algorithms in real life situations, but also carried out extensive simulation based experiments using synthetic task sets to validate the efficacy of the algorithms over varied scenarios that may be encountered.