

A SCHEDULING ANALYSIS FRAMEWORK FOR PREDICTING THE
WEAKLY HARD REAL-TIME SYSTEMS

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I declare that this thesis entitled “*A Scheduling Analysis Framework for Predicting the Weakly Hard Real-Time Systems*” is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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To my beloved husband, sons, daughter, family and family in-law

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ABSTRACT

For real-time systems, hard real-time and soft real-time systems are based on “miss restriction” and “miss tolerance”, respectively. However, a weakly hard real-time system integrates both these requirements. The problem with these systems is the limitation of the scheduling analysis method which only uses the traditional scheduling approach. Besides that, the current framework has problems with the complexity and predictability of the systems. This study proposed a scheduling analysis framework based on the suitability of scheduling algorithms, weakly hard real-time modelling and the combination of the deterministic and probabilistic schedulability analyses for predicting the weakly hard real-time tasks. Initially, the best fitting specification of a weakly hard real-time system was integrated into the proposed framework and tested in the Modeling and Analysis of Real-Time Embedded systems (MARTE) profile. The profile was enhanced because the current MARTE timing constraint restricted to the hard and soft real time timing requirement, thus some modifications were made to model the weakly hard real-time requirements. For complex systems, rather than only using scheduling algorithms to schedule the tasks, the algorithms were used with Unified Modeling Language (UML) modelling. Sequence diagram complexity factor metrics were used to measure the behavioural complexity. The proposed combination approach was applied on case studies and then evaluated with reference to the existing approaches. The results of the evaluations showed that the proposed framework is more predictable compared to the other frameworks and has addressed the problem posed in this research. In conclusion, the proposed scheduling analysis framework provides a less complex design through the behavioural complexity measurements, as well as increases the predictability of the systems.

ABSTRAK

Bagi sistem masa nyata, sistem masa nyata keras dan lembut masing-masing adalah berdasarkan "sekatan kehilangan" dan "kehilangan bertoleransi". Walau bagaimanapun, sistem masa nyata keras yang lemah menggabungkan kedua-dua keperluan tersebut. Masalah dengan sistem ini adalah keterbatasan kaedah analisis penjadualan yang hanya menggunakan pendekatan penjadualan tradisional. Selain itu, rangka kerja semasa mempunyai masalah dengan kerumitan dan kebolehamalan sistem. Kajian ini mencadangkan satu rangka kerja analisis penjadualan berdasarkan kesesuaian algoritma penjadualan, pemodelan masa nyata keras yang lemah dan gabungan analisis penjadualan berketentuan dan kebarangkalian untuk meramalkan tugas masa nyata. Pada mulanya, spesifikasi terbaik telah disepadukan ke dalam rangka kerja yang dicadangkan dan diuji dalam profil Pemodelan dan Analisis Sistem Terbenam Masa Nyata (MARTE). Profil tersebut telah dipertingkatkan kerana kekangan masa MARTE semasa terhadap kepada keperluan masa nyata keras dan lembut, dengan itu beberapa pengubahsuaian telah dibuat untuk memodelkan keperluan masa nyata keras yang lemah. Bagi sistem yang kompleks, selain hanya menggunakan algoritma penjadualan sahaja untuk menjadualkan tugas, algoritma telah digunakan bersama dengan Bahasa Pemodelan Bersepadu (UML) model. Metrik faktor kerumitan gambarajah berjujukan digunakan untuk mengukur kerumitan tingkah laku. Pendekatan gabungan yang dicadangkan telah digunakan pada kajian kes dan kemudian dinilai dengan merujuk kepada pendekatan yang sedia ada. Keputusan penilaian menunjukkan bahawa rangka kerja yang dicadangkan adalah lebih mudah diramalkan berbanding dengan yang lain dan ia telah menangani masalah yang ditimbulkan dalam kajian ini. Kesimpulannya, cadangan rangka kerja analisis penjadualan menyediakan reka bentuk yang kurang kompleks melalui ukuran kerumitan tingkah laku, serta meningkatkan kebolehamalan sistem.

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