

A SYSTEMATIC COMPONENT-BASED DEVELOPMENT PROCESS MODEL
USING INTEGRATED MARMOT AND PECOS METHODS

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I declare that this thesis entitled “*A Systematic Component-Based Development Process Model using Integrated MARMOT and PECOS Methods*“ 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 mother and father....

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ABSTRACT

Software functionality is not the only focus in Embedded Real Time (ERT) software development, but multi-constraint requirements such as timing are also important. Besides, ERT software development involves multidisciplinary knowledge that includes software, mechanical and electronic engineering fields. From this perspective, Component-Based Development (CBD) appears to be an appropriate approach in designing the ERT software development due to the ability of domain experts to interactively compose and adapt sophisticated ERT software, which decreases development time and improves software quality. The existing component technology, Pervasive Component System (PECOS) is used due to its strength of PECOS in supporting multi-constraint requirement of ERT software development. However, component technology is not adequate in supporting CBD methodology of the process model. Therefore, Component-Based Real-Time Object-Oriented Development and Testing (MARMOT) method is used to support multidisciplinary knowledge requirement. The aim of this research is to propose a systematic CBD process model for ERT software development in terms of multi-constraint and multi-disciplinary knowledge through the integrated MARMOT and PECOS metamodels. Prototype of Component-Oriented Programming (COP) tool has been developed to support CBD process model. The result of implementing the CBD process model in developing software for real Autonomous Mobile Robot (AMRs) shows that the systematic CBD process model can fulfil the multi-constraint and multi-disciplinary knowledge requirement of AMR. The integrated MARMOT and PECOS metamodel is a relevant match with the balance result of *precision*, *recall* and *MP-Measure* values as 0.4157, 0.3125 and 0.36 respectively. Meanwhile, the usability testing result of COP tool shows it could support modelling in COP phase and it is proven by the result of effectiveness (96%), efficiency (4.2 minute) and satisfaction (4.1 minute) values with reliability Cronbach α for overall questions as consistent (0.89). Thus, the main contribution of this research is to produce a systematic CBD process model for small to medium ERT software development.

ABSTRAK

Didalam pembangunan perisian Masa Nyata Terbenam (ERT), kefungsian perisian bukan satu-satunya fokus tetapi keperluan kefungsian pelbagai kekangan tambahan seperti masa juga adalah penting. Selain itu, pembangunan perisian ERT melibatkan pengetahuan pelbagai disiplin termasuk bidang kejuruteraan perisian, elektronik dan mekanikal. Dari perspektif ini, pembangunan berasaskan komponen (CBD) muncul sebagai salah satu daripada pendekatan yang sesuai untuk membangunkan perisian ERT disebabkan keupayaannya sebagai pakar domain didalam menjalin dan mengadaptasi secara interaktif perisian ERT canggih yang berupaya meggurangkan masa pembangunan dan meningkatkan kualiti perisian. Teknologi komponen PErvasive COmponent System (PECOS) digunakan dalam penyelidikan ini kerana kekuatannya dalam menyokong keperluan pelbagai kekangan didalam pembangunan perisian ERT. Walaubagaimanapun, teknologi komponen sahaja tidak mencukupi untuk menyokong kaedah model proses CBD. Lantaran itu, kaedah Component-Based Real-Time Object-Oriented Development and Testing (MARMOT) digunakan untuk menyokong keperluan pengetahuan pelbagai disiplin. Oleh itu, penyelidikan ini mencadangkan model proses CBD yang sistematik untuk membangunkan perisian ERT didalam skop masalah pelbagai kekangan dan disiplin pengetahuan melalui penyatuan metamodel MARMOT dan PECOS. Sebuah prototaip alat komponen berasaskan aturcara (COP) dibangunkan untuk menyokong model process CBD. Hasil perlaksanaan pembangunan perisian Autonomi Robot Mudah Alih (AMR) yang sebenar keatas model process CBD yang dicadangkan didapati mampu memenuhi keperluan pelbagai kekangan dan disiplin pengetahuan keatas AMR. Penyepaduan metamodel MARMOT dan PECOS adalah padanan yang sesuai dengan nilai ketepatan, panggilan semula dan pengukuran-MP masing-masing adalah 0.4157, 0.3125 dan 0.36. Sementara itu, keputusan ujian kebolehgunaan keatas prototaip alat COP menunjukkan ianya mampu menyokong permodelan didalam fasa COP dan ia terbukti melalui hasil keberkesanan (96%), kecekapan (4.2) dan kepuasan (4.1). dengan kebolehpercayaan Cronbach α bagi keseluruhan soalan adalah konsisten (0.89). Oleh itu, sumbangan utama dalam penyelidikan ini ialah menghasilkan model process CBD yang sistematik bagi membangunkan perisian ERT yang bersaiz kecil dan sederhana.

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