Industrial needs ROSATEA06

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Abstract

Component based software engineering is a promising approach for efficient software development, enabling well defined software architectures as well as reuse. Although component technologies have been developed addressing different demands and domains, there are few component technologies targeting the specific demands of safety critical embedded real-time systems.

Testing constitutes a major part of the budget in all software development projects; however, embedded systems which are often mission-critical needs to be extensively verified, and testing is one of the major challenges. Thus reuse of software components should ideally imply reuse of testsuites and results.

This paper discusses future testing challanges considering built-in tests in component-based systems.

1 Introduction

Embedded systems are distributed systems comprising of electronics and software. Such systems are increasingly penetrating every aspect of our lives and work, from telecommunication systems, transport, energy and utilities, health, finance, education, tourism and environment. The embedded systems industry is competing with decreasing time to market and increasing product differentiation. Both lead to increasing dependence on software required to be flexible enough for rapid reuse, extension and adaptation of system functions.

It is often difficult to test and verify embedded systems because of the intrinsic “embedded dimension”. This is an effect of that the software has to be designed on a platform different from the platform on which the application is intended to be deployed and targeted. Embedded systems are also often mission-critical and needs to be extensively verified and testing is one of the major challenges. Compared to standard PC software embedded software is harder to observe, test, and debug.

In this paper we aim to cover the viewpoints of both component developers and component users on problems of COTS components verification and validation during components integration in component based systems assembly. We encompass functional requirements such as correctness and functionality compliance as well as *extra functional requirements* like timeliness and safety.

The contribution of this work is the discussion considering future research areas within BIT for component-based embedded systems.

1.1 CBSE for Embedded Component based Systems

Assembling new software systems from existing components is an attractive alternative to traditional software engineering practices which promises well defined software architectures, reduced development costs as well as reuse. However, these benefits will only occur if separately developed components can be made to work effectively together with reasonable effort. Lengthy and costly verification and acceptance testing directly undermine the benefits of independent component fabrication and late system integration. This forces the application of new processes, approaches and instruments for supporting effective integration and reducing manual system verification effort, by equipping components with the ability to check their execution environments at runtime. Built-in-test (BIT) is such an instrument, providing a model for elaboration of detailed tests while developing the component.

Most embedded systems have requirements not present in other systems, e.g., timeliness, low footprint, low energy consumption, etc. Such *extra-functional requirements* needs to be verified and vaildated, adding another dimension of testing to the system. Hence, it is essential to satisfy not only the functional behaviour, but also of extra-functional properties such as, e.g., timing and dependability attributes. These systems characteristics usually implies that embedded systems are statically configured, i.e., the components used and their interconnections are decided at design or configuration time. Hence, the binding is static, as opposed to the dynamic binding used in most desktop component technologies.

Furhtermore, embedded systems are resource constrained in the sense that the per-unit cost is a main optimization criterion, i.e., the use of computer and computing resources should be kept at a minimum. Also, due to the ”product-line nature” of the industry, reuse of architectures, components, quality assessments and tests is very attractive for reducing development costs.

1.2 Built in Testing Overview

2 Built-in testing towards analyzability and predictability

3 Research challenges

4 Future work

5 References