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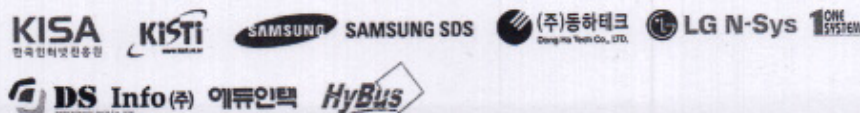Shandong University at Weihai, China.
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Title & Abstract Pages

Test Case Extraction based on Use Case Approach for Heterogeneous Embedded System

Dong ho Kim[1], Woo Yeol Kim, Hyun Seung Son, Hyung-Mook Lee[2], HeaKyung Seong[3], R Young Chul Kim*

[1] Dept of Computer Information Comm, Hongik University, 339-701, Korea
[e-mail: ray@selab.hongik.ac.kr]
[2] Dept. Comuter Science, MyongJi College, Korea
[e-mail: Khm1022@mjc.ac.kr]
[3] Dept. Of Computer Science & Information System
[e-mail: Hkseong@hywoman.ac.kr]
*Corresponding author: R Young Chul Kim

Abstract

Recently on smart embedded markets, it changes suddenly with emerging new various platforms such as i-phone, Android, Window mobile, and Bada Platforms. Due to this, application developers spend a lot of time to implement its appropriate software per each different platform. To reduce development time, this paper suggests to develop heterogeneous software with MDA paradigm. However, testers also should test each application developed on each different platform. To solve this problem, this paper mentions to generate heterogeneous test cases on Use Case approach.

Keywords: MDA, Heterogenous, Test process, testcase

1. Introduction

Recent embedded software systems depended on particular hardwares are used on very diverse area [1]. But it may be very difficult to reuse the exsiting software to heterogeneous embbeded system depended on hardware[2][3]. We proposed to apply MDA (Model Driven Architecture) for embbeded system, which was generated its own software per each depended target [4][5][6]. This development approach did generate heterogeneous code from model, which was development oriented approach. But it can not guarantee quailty of the generated code. The existing testing approaches also make effort to generate a number of test cases to test the system on test procedure, and use redundantly the test cases.

The problem is to spend too much time and cost to generate and test all possible test cases per each target system. To solve this, we suggest to extract test case based on Use Case Approach, which adapt MDA paradigm for heterogeneous test cases.

Also the existing test process for embedded system doesn't consider what size of test organization and members, but just mentions general test procedures.

This paper also just mentions embbedded test process based on MDA paradigm.

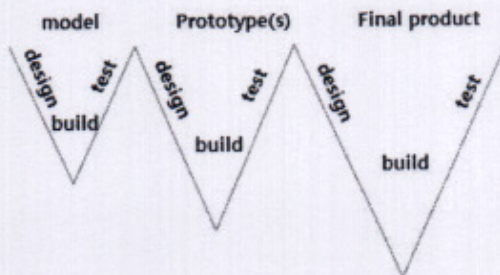## 2. The existing embedded development process

Fig. 1. Multiple V-Model development lifecycle [3]

In **Fig. 1**, the existing embedded software development process consists of three parts such as Model, Prototype, Final product[3]. This approach is limited on single products, but not mentions about how to test. This is also difficult to reuse software for hetrogeneous smbedded systems.

Kim[4] adapted MDD(Model Driven Development) to develop embedded software for heterogeneous embbeded systems based on multiple V-model development lifecycle[3].

This method developed target specific model based on target independent model, and then generated code with target specfic model, which was possible to reuse target independent model. This is limited automatically to generate target specific model from target independent model.

But with automation for model transformation and code generation, it is very easily and fast to develop heterogeneous complex embedded systems.
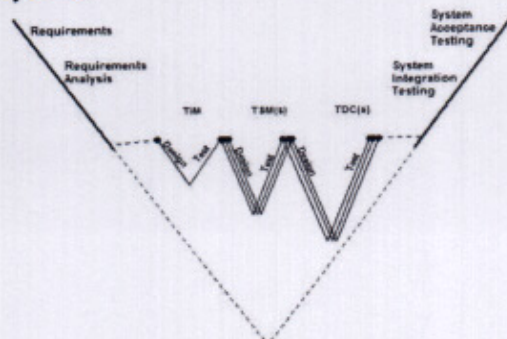

Fig. 2. Multiple V-Model[4]

This Multiple V-model consists of TIM(Target Independent Model), TSM(Target Specific Model), TDC(Target Dependant Code). This approach is to develop heterogeneous TSM(Target Specific Model) from TIM(Target Independent Model), which is possible to generate software code with TSM. It is possible to reuse TIM for converting TSM. But it is not enough to mention test in this approach[4]. So it needs to emphasize test approach on it. On this process, it really needs to work with development process and test process simultaneously.

3. Double Multiple V-model for heterogeneous embedded software development and test process

We suggest double multiple V-model, which works with development process and test process simultaneously. During this approach, TIM will be as mata-design, which uses as mata-test. We can convert a TSM and Test Model on each diverse embedded platform from TIM. At this TSM stage, we identify elements for the basic structure of test case (input, precondition, postcondition, output) based on use case model, sequence diagram, state diagram. On development process, we develop gerenral model called Targer Independent Model at TIM stage, convert specific model called Target Specific Model at TSM stage, and then generate Code based on each TSM per different platform(or target). On test process, also make general test case with TIM mode, and then also detailed test case with each TSM per different platform (or target).
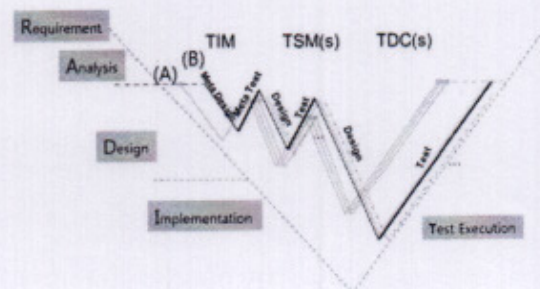

Fig. 3. Double Multiple V-Model

In **Fig. 3**, it shows to work both development (A) and test process (B) simultaneously. From the problem of the existing process, we should work much more test endeavors than the existing process. In (A) of **Fig. 3**, it does work to

generate code with TSM via TIM on its procedures. In **Fig. 4**, it shows in detail how to work test procedures (Test requirement, Test Analysis, Test Design, Test Implementation, and Test Execution) in (B) of **Fig. 3**.
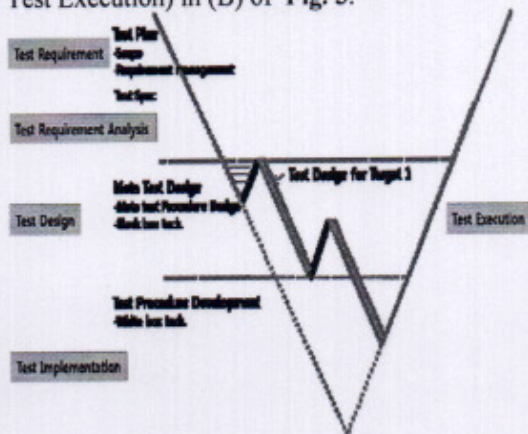
Fig. 4. Test Process

This process invloves to generate heterogenous test case based on MDA mechanism.

4. Test Case Extraction Based on Use Case Approach

On developement process, it invloves to model with UML Sequence, and State Diagram at TIM(Target Independent model) stage, and refine model depended on speical target at TSM(Target Specific Model) stage. On Test Process, simultaneously it extracts test scenarios with TSM models on develpoment process. Then it is created test cases with these test scenarios. **Fig. 5** shows heterogeneous test process, which proceeds to make test cases via test scenaios from TSM.
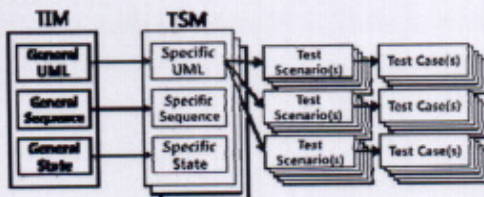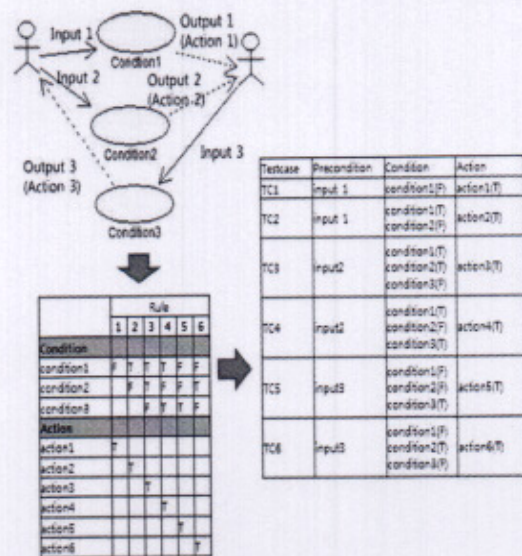

Fig. 5. Heterogeneous Test Process

Fig. 6. Test case from Use case Diagram

It is extracted Decision table with analying information(input, condition, output) on each UML, Sequence, and State diagram in **Fig. 6,7,8**.
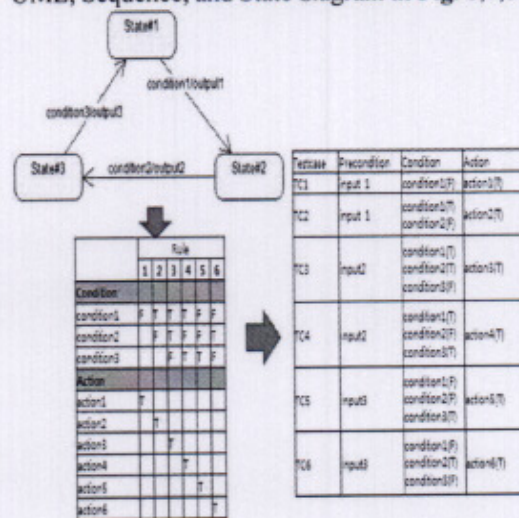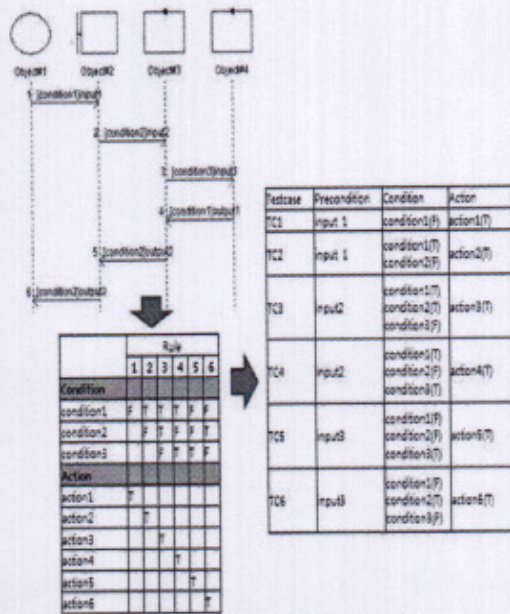

Fig. 7. Test case from State Diagram

Fig. 8. Test case from Sequence Diagram

Then, it is created test case with decision table respectively in **Fig. 6,7,8**. This approach involves a detailed-level test case based on requirement specification with TSM. If using TIM, it is high-level test case approach. Now, we will be considering of the abstract maturity level of test for object oriented software development (OOSD) because the existing testing approachs are not exactly applied for OOSD, and also how to reduce test cases with Pairwise test techique and Orthogonal array.

5. Conclusion

This paper mentions Double Multiple V-Model simultatnously for Development and Tesing process, which is adapted testing approach with MDA mechanism. The existing process involves dependant on a hardware device. It is very difficult to support testing on various and rapid changing envirnment. As adopting this testing approach with MDA mechanism, it may be generated heterogeous test cases per specific target.

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