LTS-BT:
A tool to Generate and Select Functional Test Cases for Embedded Systems

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Agenda

• Introduction
  – Feature
  – Feature Interruption
• LTS-BT Architecture
• Case study
• Concluding Remarks and Future Works
Introduction

- **Testing** activity is crucial to the **success** of a software project
  - This activity **requires about 50%** of software development resources

- **Automation** of software testing activities can reduce **costs** and promote **reliability** in testing.

- LTS-BT: A tool to Generate and **Select** Functional Test Cases
  - One kind of embedded systems: **Mobile Phone Applications**
Mobile Phone Applications - Feature

- Mobile phone applications are called **features**.

  - Feature is a set of individual requirements that describe a cohesive unit of functionality.

![Diagram showing features]

- **Message**:
  - Send
  - Receive

- **Phonebook**:
  - Add
  - Remove

- **Calculator**:
  - Sub
  - Add
  - Div
  - Mult
Feature Interruption

• When another feature (running in background) interrupts the execution of a feature running in foreground

The Message feature is interrupted by Incoming Call feature
• **LTS-BT** is a test case generator and selector tool.
  
  – Feature testing and feature interruption testing
  
  – Model-Based Testing
  
  – The inputs are:
    
    • **Behavioral model**
      
      – Sequence Diagrams or Labelled Transition Systems;
    
    • **Test Purpose**;
    
    • **Path Coverage Percentage**.
  
  – The outputs are:
    
    • **Abstract test cases**
LTS-BT Tool - Architecture

Sequence Diagram
MDL/RTMDL
Rose/RoseRT Tools

LTS-BT
Parser MDL/RTMDL
Model Filter
Generator
Selector
Test Purpose
% Path Coverage
Test Cases

This module executes the derivation from MDL/RTMDL to AUT model
LTS textual notation

Test Purpose
% Path Coverage
Test Cases

This module executes the derivation from MDL/RTMDL to AUT model
This module obtains the model that attends the test purpose.
LTS-BT Tool – Architecture – Model Filter

(a) LTS-BT Tool – Architecture – Model Filter

(b) LTS-BT Tool – Architecture – Model Filter
This module generates the test cases by traversing an LTS starting from initial state.
This module aims to reduce the number of test cases according to path coverage percentage.
Case Study

HOT MESSAGE
FEATURE

steps ➔ Input Actions
conditions ➔ conditions associated with input actions
expectedResults ➔ Expected outputs
Case Study

HOT MESSAGE FEATURE interrupted by INCOMING MESSAGE FEATURE
Test Purpose

*"Incoming Message" alert is displayed,* Message storage is not full

<table>
<thead>
<tr>
<th>Steps</th>
<th>Expected Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Go to &quot;Message Center&quot;</td>
<td>&quot;Hot Message&quot; folder is displayed</td>
</tr>
<tr>
<td>Send a message from phone 2 to phone under test</td>
<td>&quot;Incoming Message&quot; alert is displayed</td>
</tr>
<tr>
<td>Select &quot;Read&quot; option</td>
<td>Message is displayed</td>
</tr>
<tr>
<td>Select &quot;Move to Hot Message&quot; option</td>
<td>Back to application that was launching before the incoming message interruption</td>
</tr>
<tr>
<td>Go to &quot;Inbox&quot;</td>
<td>All inbox messages are displayed</td>
</tr>
<tr>
<td>Scroll to a message</td>
<td>Message is highlighted</td>
</tr>
<tr>
<td>Go to &quot;Context Sensitive Menu&quot;</td>
<td>&quot;Move to Hot Message&quot; option is displayed</td>
</tr>
<tr>
<td>Select &quot;Move to Hot Message&quot; option</td>
<td>&quot;Message moved to Hot Message folder&quot; is displayed</td>
</tr>
</tbody>
</table>
Test Selection based on Similarity

– Input:
  • Behavior model
  • Percentage of test cases to be execute

– Output:
  • the less similar test cases.

• We defined the percentage on 50% for 3 applications and we observed the percentage of excluded transitions.

<table>
<thead>
<tr>
<th>Test Selection Method</th>
<th>AP1</th>
<th>AP2</th>
<th>AP3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Random Test Selection</td>
<td>24,93%</td>
<td>36,10%</td>
<td>27,22%</td>
</tr>
<tr>
<td>Similarity Based Selection</td>
<td>1,23%</td>
<td>11,98%</td>
<td>1,70%</td>
</tr>
<tr>
<td>Number of Test Cases</td>
<td>24</td>
<td>66</td>
<td>153</td>
</tr>
</tbody>
</table>
Concluding Remarks and Future Works

• Automation of feature and feature interruption testing is proposed

• The inputs are:
  – sequence diagrams
  – annotated LTS

• A tool was presented

• Ongoing works
  – To incorporate other selection strategies
  – other kinds of embedded systems
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