A Process to Increase the Model Quality in the Context of Model-Based Testing

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Introduction

- OMICRON (www.omicron.at)
  - International company serving the electrical power industry with innovative testing and diagnostic solutions
  - Diagnostic of protection relays, instrument and power transformers
  - Located in Vorarlberg, Austria
  - ~ 700 employees

- Software is being written for our measurement devices
  - Scaled Agile Framework as development approach
  - 4 SCRUM teams -> 30 team members
  - .NET framework and C# for PC software
  - Mainly C++ for embedded software
Motivation

Sprint n

Phase 1: Product Owner, Usability Expert
- Epic
  - is derived from User Story

Phase 2: SWQA
- Paper Draft Usage Model
  - is derived from

Phase 3: SWQA
- Formal Usage Model
  - is derived from

Phase 4: SWQA, PO, Devs
- n review iterations
  - Reviewed Usage Model

Legend:
- Epic
- User Story
- Paper Draft Usage Model
- Formal Usage Model
- Reviewed Usage Model
Challenges

• **How to** avoid information loss during the derivation of models from the textual requirements by the software quality engineer (SWQA)?

• **How to** reduce the maintainability effort of usage models?

• **How to** allow the less-experienced SWQA the application of model-based testing approaches?
The Process

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**Phase 1: SWQA, PO, UE**
- Derive User Story from Epic
- Define Exemplary Happy Paths
- Generate Partial Usage Model
- Review Partial Usage Model
- Partial Usage Model Correct?
- Yes
- No

**Phase 2: SWQA**
- Define Alternative Paths
- Generate Usage Model from Happy and Alternative Paths
- Enhance Usage Model
- Usage Model Complete?
- Yes
- No

**Phase 3: SWQA, PO, DEV**
- Generate Test Cases
- Review Usage Model
The Process: Implementation

- Selection of the formal notation
  - Requirement 1: it is possible to derive a subset of UML state-charts
  - Requirement 2: contain as much natural language as possible
  - Requirement 3: minimize the number of new tools to introduce the process

- Industrial and academic literature research
  - New domain specific language (DSL) vs. the existing one
  - Existing DSL: Gherkin (Behaviour Driven Development)

- Transform Gherkin into a subset of UML state-charts
  - First idea in 2008 in an industrial blog [1]
  - First case-study in Scerri [2] 2014 showed promising results
Case Study: General Facts

• Primary Test Manager (PTM) supports the workflow for analysing the condition of transformers
  • Jobs are executed on assets which are assigned to locations
  • System size: approximately 400,000 LOC

• PTM Server Integration
  • Client-server application which allows the synchronization of jobs to a server
  • Feature under test: synchronisation of a single job to a server

• Toolchain
  • *Gherkin* for Visual Studio -> SpecFlow
  • *Gherkin* to state-chart -> dedicated tool (*Text2Mod*)
  • Visualization by *yED* editor
  • Test case generation by *TAI* Framework [3]
Case Study: Example of Gherkin Path Definition

#Begin of the Happy Path 2 (defined by P0)

Scenario: [ID=5] Customer changes an existing job asset and job location

Given [ID=1] Customer starts PTM

When Customer changes an existing job asset and job location

<table>
<thead>
<tr>
<th>JobName</th>
<th>LocationName</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trafo3W</td>
<td>New York</td>
</tr>
</tbody>
</table>

Then job asset and job location are changed

<table>
<thead>
<tr>
<th>JobName</th>
<th>LocationName</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trafo3W</td>
<td>New York</td>
</tr>
</tbody>
</table>

Scenario: [ID=6] Customer creates and syncs a Job based on existing Location/Asset

Given [ID=5] Customer changes an existing asset and location

When Customer creates new job and then he clicks Synchronize in the job context menu

<table>
<thead>
<tr>
<th>JobName</th>
</tr>
</thead>
<tbody>
<tr>
<td>NewCTtest</td>
</tr>
</tbody>
</table>

Then The new job is uploaded

<table>
<thead>
<tr>
<th>JobName</th>
</tr>
</thead>
<tbody>
<tr>
<td>NewCTtest</td>
</tr>
</tbody>
</table>

#End of the Happy Path 2 (defined by P0)
Case Study: Example of Generated Usage Model

Start → An server database with existing Assets and Locations

Customer starts PTM

PTM is running

Customer creates Location A

Customer creates a new Asset

Location is created

Customer creates a new Job and then he clicks Synchronize in the job context menu

Asset is created

Customer opens the job and he chooses the update master asset and location option

real world asset and location are changed

Customer opens the job and selects update job asset and job location option

The job asset and job location are updated

Customer presses the Websync button

The new job is uploaded

Customer clicks Close Manage button

job asset and job location are changed

Customer changes an existing job asset and job location

The job is created

Customer relocates an asset

The asset and all the created job are relocated

Customer creates a new job and then he clicks Synchronize in the job context menu

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Case Study: Evaluation

• Approach presented to the product owner (PO)
  • 7 minutes needed to explain the notation
  • 5 minutes needed by the PO to define one happy path and to review the partial model

• SWQA needed approx. 90 minutes to define the set of alternative paths

• The final usage model review took around 30 minutes

• The final usage model consisted of 11 states and 14 transitions

• General feedback
  • PO could imagine using the notation
  • Usability improvements needed
Possible Limitations and Future Work

- Automatically generated model needs to be enhanced by the SWQA to fully comply with UML
- PO has a different perspective on the requirements than SWQA thus he possibly might omit certain aspects while defining the set of happy paths
- Future work 1: evaluate the approach in other PTM teams
- Future work 2: explore the possibility of reusing certain scenarios across different teams
- Future work 3: increase the usability of the approach
Thank You for Your Attention
Literature

https://sites.google.com/site/unclebobconsultingllc/the-truth-about-bdd


Master’s thesis, Technical University of Graz, 2012