“HERMES: A TOOL FOR TESTING MOBILE DEVICE APPLICATIONS”

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Agenda

- Introduction
- Requirements
- Design
- Evaluation and Results
- Requirement Traceability
- Related Work
- Conclusion, Extensibility and Future Work
Need

Mobile phone subscribers per 100 inhabitants 1997-2007

- Developed
- Developing
- World
Problem

- Heterogeneity in mobile platforms
- Use of Virtual Machines – not so helpful
- Device Emulators – not so helpful
Users
Hermes – An Overview

- Supports black box testing of Java applications
- Runs in J2ME environment
- Deploys application on multiple devices
- Executes set of test cases and generates report
- Device independent test cases
- Aesthetics, Functional and Environmental tests
Requirements

1) Automatically deploy applications, execute tests and generate reports
2) Support multi-faceted black-box testing

<table>
<thead>
<tr>
<th>Facet type</th>
<th>Test concern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aesthetics</td>
<td>Layout, Color, Font</td>
</tr>
<tr>
<td>Environment</td>
<td>Response time, Memory usage, Network availability and selection, Power consumption</td>
</tr>
<tr>
<td>Functional</td>
<td>Content, Navigability</td>
</tr>
</tbody>
</table>
Requirements

3) Consume minimal resources on mobile devices
4) Be application independent
5) Be extensible with respect to test case specification and processing
6) Provide benefit at low cost
Design

Table 2. XML schema elements for test cases

<table>
<thead>
<tr>
<th>Test element</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>testScript</td>
<td>Exactly one testScript element contains one or more test elements.</td>
</tr>
<tr>
<td>test</td>
<td>Describes a test case in terms of remaining elements.</td>
</tr>
<tr>
<td>action</td>
<td>A function that is to be simulated on a Midlet application.</td>
</tr>
<tr>
<td>componentName</td>
<td>The name of the component to which action relates.</td>
</tr>
<tr>
<td>componentType</td>
<td>The type of the component named by componentName, for example Button or TextField.</td>
</tr>
<tr>
<td>inputValue</td>
<td>Any value that is to be provided as input by the simulated user.</td>
</tr>
<tr>
<td>displayType</td>
<td>The component’s display type, such as Form.</td>
</tr>
<tr>
<td>expectedOutput</td>
<td>The expected behaviour of the test.</td>
</tr>
<tr>
<td>actionDescription</td>
<td>A brief description of the test.</td>
</tr>
</tbody>
</table>

Communication module - Bluetooth

Figure 1. Hermes architecture
<testScript>
  <test>
    <action>command</action>
    <componentName>OK</componentName>
    <componentType>Command</componentType>
    <displayType>Form</displayType>
    <expectedOutput>Notes</expectedOutput>
    <actionDescription>
      Press the OK button
    </actionDescription>
  </test>
  <test>
    <action>aestheticsLayout</action>
    <componentName>Add Food Type</componentName>
    <componentType>Form</componentType>
    <displayType>Form</displayType>
    <expectedOutput>
      Component Name=Subject, Alignment=Left;
      Component Name=Deadline, Alignment=Left;
      Component Name=Alarm, Alignment=Left;
      Component Name=Priority, Alignment=Right;
    </expectedOutput>
    <actionDescription>
      Check the alignment of all the components on the form
    </actionDescription>
  </test>
  <test>
    <action>getMem</action>
    <componentName>Manager</componentName>
    <componentType>Midlet</componentType>
    <displayType>Midlet</displayType>
    <expectedOutput>
      Less than 200000 bytes
    </expectedOutput>
    <actionDescription>
      Inspect memory usage
    </actionDescription>
  </test>
</testScript>

Figure 2. Sample test script
Test Script Preparation

- GUI Visual Modeller and Test Script Generator
- Generates XML Test Script
Test Script Execution

- Test Script Execution Automaton, Communication Module, Test Agent
- Communication Module – Bluetooth
- XML Test Scripts -> Executable Tests
- Sends small number of test requests at a time
- Test Agent uses reflection to observe and supply i/p to the AUT(Application Under Test)
Report Generation

- **Test Report Generator**
- Via XSLT, test results to HTML format

![Hermes Execution Test Results](image)

Figure 3. Sample report
Evaluation

- Comparative experiment involving use of Hermes vs. Manual Techniques.
  - 2 groups tests 2 applications
  - Faults introduced
  - Time bound, 10 minutes – manual, 25 minutes – Hermes
  - Likert scale questionnaires and feedback

- Comparative experiment of real vs. emulated behavior
Results

92% defects found by Hermes vs. 46% manually - JavaDiet

100% defects found by Hermes vs. 21% manually - ToDoManager
Requirement Traceability

1) Automatically deploy applications, execute tests and generate reports
   ○ No automatic deployment

2) Support multi-faceted black-box testing
   ○ Governed by the capabilities of J2ME API. Ex. GUI layout and component positioning can be inspected but not color
Requirement Traceability

3) Consume minimal resources on mobile devices
   Conserves memory by strategy implemented by the communication module

4) Be application independent

5) Be extensible with respect to test case specification and processing

6) Provide benefit at low cost
Related Work

- Capture / Replay approach – cannot be used until AUT is developed
- Specification based, GUI expressed in XML
- *Test Quest Pro, Digia AppTest, MobileTest* – rely on combination of image comparison, OCR and audio comparison – partial automation
Conclusion, Future Work & Extensibility

- Mainly built to expose the effects of device heterogeneity
- Modular design – hence can be extended
- Missing *Action* issue dealt with by the PC
- Extensive evaluation
- Investigate aggregate reporting
- Developing probes allowing device data to be extracted
Thank you

- for everything else, we test!