Energy Testing and Optimization of Mobile Applications

Eclipse Testing Day 2013

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25.09.2013
Mobile Devices

<table>
<thead>
<tr>
<th>Manufactured</th>
<th>~1850</th>
<th>2011</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operation time</strong></td>
<td>1–2 days</td>
<td>8 hours (3G)</td>
</tr>
<tr>
<td>Services</td>
<td>1</td>
<td>Several thousands (apps)</td>
</tr>
</tbody>
</table>
In Numbers ...

- “I am satisfied with the operation time of today’s mobile devices while running on battery power.”

![Bar Chart]

**Basis:** Online Survey conducted between September 9th and September 19th, 2013 (104 Participants).
“It started to drain the battery and having loooooooooooooong load times. This must be the worst update off all.”

(Glenn)

„Used 5% of my battery within five minutes.”

(Shawn)

„I would like to logout during the night so it doesn't kill my battery.”

(Brittany)
Analyzing User Feedback

- **App stores comprise many user comments**
  - Search for complaints about energy-efficiency
  - Analyzing user feedback systematically [WRG+13]

Findings (1/3)

- Every sixth Android app has energy bugs [WRG+13]

  - 18.6% of all apps
  - Energy bugs affect grades (-1.8☆)

Findings (2/3)

- Frequent causes for unwanted energy consumption
  - Unnecessary background activities
  - Faulty synchronization mechanisms
  - Advertisement banners
  - Unnecessary display usage
  - ...  

→ Software bugs

Findings (3/3)

- Many bugs are introduced by software updates

Conclusion

1. Mobile application users dislike energy wastes

2. In several cases, they are caused by faulty software (aka. energy bugs)
Targets

1. Detection and correction of energy bugs

2. Development of energy-aware mobile applications
Solution: Energy Testing

- **JUnit extension JouleUnit** [WGR13]

- **Workloads are defined as unit tests:**

  ```java
  testSendMail() {
      robot.enterText("To", "ex@example.com");
      robot.enterText("Msg", "Hi Ex, ...");
      ...
      robot.clickOnButton("Submit");
  }
  ```

- **Execution and parallel energy profiling:**
  consumption values for use cases or individual method calls

- **Currently support for Android-operated devices**

Energy Testing

- Reproducible test runs
- Reuse of functional tests possible
- Well-known methodology → low learning curve
JouleUnit Workbench

- **Constructing and triggering energy tests from Eclipse**
- **Local execution**
  - On testing device or emulator
  - Use of battery API
  → *Coarse-grained results*
- **Remote execution**
  - Deployment of test devices
  - Hardware-based profiling
  → *Fine-grained, accurate results*
Demo

The Energy-Aware App Store

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QMark

• **Energy profiling as a service**

• **Execution on remote test infrastructure**
  • Automated test runs on real Android devices
  • Multiple runs possible

• **Execution & inspection**
  • Web frontend
  • Eclipse client
Possible Use Cases

1. **Detection of energy bugs**
   - Exploratory testing / debugging

2. **Impact Analysis for new features**
   - E.g., influence of advertisement

3. **Background test**
   - Consumption of applications in idle modes

4. **Energy regression tests**
   - Detection of energy bugs during continuous integration
   - Avoidance of bad updates and software releases
Current Status

- **JouleUnit available open source**
  - Feel free to
    - Download
    - Test
    - Improve

- **Profiling as a Service**
  - First running version online
  - User accounts available soon
Beyond JouleUnit

- **Energy testing is still testing**
  - What can be done beyond testing?

- **Anti-pattern detection**
  e.g., wakelocks [PJHM12]

- **Energy refactorings**
  correcting anti-patterns [GJJW12]

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Summary

• **Energy bugs influence usability** and thus, ...
  • User ratings,
  • Downloads,
  • Sells

• **Target: development of energy-aware mobile apps**
  • Unit-test based energy profiling
  • Profiling as a Service

• **Possible use cases**

• **Interested?** Call us!
Thank you!

• **More information:**
  • http://www.qualitune.org/
  • http://www.jouleunit.org/

• **Contact:** claas.wilke@tu-dresden.de

• **Survey in progress:** http://survey.jouleunit.org/

Questions?
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