TestAWARE: A Laboratory-Oriented Testing Tool for Mobile Context-Aware Applications

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Context-Awareness
Bugs in Mobile Apps
Testing and Maintenance: 50% budget
Testing Mobile Context-Aware Apps

More challenging!

Mobile Bugs...
Testing a Car-Crash-Detection App
Write a Failing Test → Refactor → Make the Test Pass → Write a Failing Test
Testing a Fall-Detection App
Testing Apps for Chronic Disease
Types of Testing

Functional
- Unit Testing
- Integration Testing
- Smoke / Sanity
- User Acceptance
- Localization
- Globalization
- Interoperability
- So on ...

Non-Functional
- Performance
- Endurance
- Load
- Volume
- Scalability
- Usability
- So on ...

Maintenance
- Regression
- Maintenance
Testing Mobile Context-Aware Apps

Challenges:

1. Acquisition of test data (test cases)
2. Longitudinal dataset
3. Diversity of testing tasks
Laboratory Testing Needed
Laboratory Testing Loop
TestAWARE: A Laboratory-Oriented Testing Tool

Supporting:

1. Replay test data (many types/sources)
2. Replay speed control (faster/slower)
Data Types

AWARE Framework

http://www.awareframework.com/
Data Sources

- Simulated Data
- Historical Data
- Real-time Data
Replaying Data for Lab Test
Recording/Observing Results

Intended Context → App → Result Recorder
Speed Control of Replay

1. Fast replay for longitudinal datasets
   a) Using recalculated timestamps
Speed Control of Replay

Also supports sensor + audio data
Optimisation of Replay

Concurrent data replay for multiple sensors using Java 8 concurrency package
Black + White Box Testing Support
Task: 1+1

Output

Expected Value: 2

Compare
Non-functional Testing

1. Machine Learning Accuracy (Classification/Regression)
2. Power Consumption Estimation
3. Processing Speed Measurement
Expected Values and Output of Machine Learning

Expected Values

Output

Time
Expected Values and Output of Machine Learning

Expected Values

Delay Tolerance

Output

Time
Evaluation: Maximal Replay Speed

1. Device: 6 phones, 6 tablets, 2 PCs

2. Data: Sensor readings, OS events, raw audio data

3. On a single thread
Max Audio Replay Speed

- G1-1
- G1-2
- G1-3
- G2
- Nexus 5
- S6
Max Audio Replay Speed

Multiple of the Original Speed

Emulator:
- Nexus 10 MacBook
- Nexus 10 Mini
- Nexus 5 MacBook
- Nexus 5 Mini
Evaluation: User Study

1. Participants: 13 pro developers
2. Tasks with a buggy real-world app:
   a) Black Box Testing
   b) Functional/Non-Functional White Box Testing
User Study Findings

1. A wrong prediction may not be a bug
2. White Box Testing is very effective to find and locate a bug
3. The replay feature reproduces bugs well
Limitation and Future Work

1. The fragmentation problem for replay
2. Design and implementation for iOS
3. Testing tools for smartwatch and wearable computers
Take-away Points

1. Laboratory-oriented testing with data replay is necessary
2. We must match expected values and output
3. Replaying data on PC emulators is significantly faster
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