



Cross-Detection of Mobile-specific Energy Hotspots: MBSE to the Rescue

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23rd September 2024. Linz, Austria



Background

Mobile-Specific Energy Code Smells



10 cross-platform Energy Code Smells

| Leakage | |
|---------------------|---|
| Sensor Leak | Always remember to unsubscribe from a sensor once you have subscribed to it to avoid wasting data acquisition |
| Idleness | |
| Keep Screen On | Never prevent the device from going to sleep after a certain time to avoid draining the battery in just a few hours |
| Rigid Alarm | Applications are strongly discouraged from using exact alarms unnecessarily as they reduce the OS's ability to minimize battery use |
| Power | |
| Charge Awareness | Adapt workload accordingly when the device is connected/disconnected to a power station or switch to a different battery level |
| Save Mode Awareness | Adapt workload accordingly when energy save mode is activated intentionally by the end-user or by the system |
| Sobriety | |
| Thrifty Geolocation | Configure the geolocation sensor (aka GPS) in a less accurate mode and with a lower position update rate |
| Dark Mode | Dark themes should be preferred to light themes as this can affect the AMOLED display under certain conditions |
| Brightness Override | Don't override the screen brightness value, which automatically adjusts to ambient light to save energy |
| Animation-free | Avoid extraneous animations, which consume a lot of power as they require the CPU, GPU and screen to be active |
| Torch-free | Don't programmatically activate the LED flashlight, a notoriously power-hungry component |





Background

Energy Code Smells Detection



ecoCode

Energy Code Smells Detection with SonarQube[™]





Motivating Example



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Motivating Example

Requirements



RQ1: Energy code smells should be described at the highest abstraction level, independent of any specific programming language

RQ2: Energy code smells should be defined once and reused for as many mobile code translations as necessary.

RQ3: Translations into a targeted language should be independent of any specific static analysis tool.

RQ4: The definition of an energy code smell, its translation, and the code generation model for a static analysis tool should be achievable iteratively and by different actors.



Proposed Approach

Energy Code Smell meta-model



- 1 Name: Torch-free
- 2 **Description:** Don't programmatically activate the LED flashlight, a notoriously power-hungry component
- 3 **Score:** -2
- 4 #Sobriety @Flashlight



Proposed Approach

Platform-Specific Energy Code Smell meta-model



Proposed Approach

Model-to-Code Transformation (SonarQube API use case)

```
public class TorchFreeRule extends ArgumentValueOnMethodCheck {
1
2
     public TorchFreeRule() {
 3
       super("setTorchMode", "android.hardware.camera2.CameraManager", true);
4
     }
5
     @Override
 6
     protected void checkConstantValue(Optional<Object> optionConstantValue, Tree reportTree, Object
7
                                                                                              constantValueToCheck) {
       if(optionalConstantValue.isPresent() && (optionalConstantValue.get().equals(constantValueToCheck)
8
                                                                     ((Boolean) optionalConstantValue.get()))) {
         reportIssue(reportTree, getMessage());
9
10 \}\}
```

```
public class TorchFreeRule extends SwiftRuleCheck {
1
 2
     @Override
 3
     public void apply(ParseTree tree) {
 4
       if (tree instanceof Swift5Parser.ExpressionContext) {
 5
         Swift5Parser.ExpressionContext id = (Swift5Parser.ExpressionContext) tree;
 6
         String expressionText = id.getText();
7
         if (expressionText.contains("AVCaptureTorchMode.on") || expressionText.contains("setTorchModeOn") ||
8
                                                                          expressionText.contains("torchMode=.on")) {
           this.recordIssue(id.getStart().getStartIndex(), DEFAULT_ISSUE_MESSAGE);
9
10
  }}}
```



Motivating Example



Questions?

Proposed Approach

Energy Code Smell meta-model



- 1 Name: Torch-free
- 2 Description: Don t programmatically activate the LED flashlight, a notoriously power-hungry component
- 3 Score: -2

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4 #Sobriety @Flashlight



Proposed Approach

Platform-Specific Energy Code Smell meta-model



- "AVCaptureTorchMode.on" OR "setTorchModeOn" OR "TorchMode.on"
- 7 }

3 4 }

6