High-Accuracy Energy Measurements on Mobile Devices

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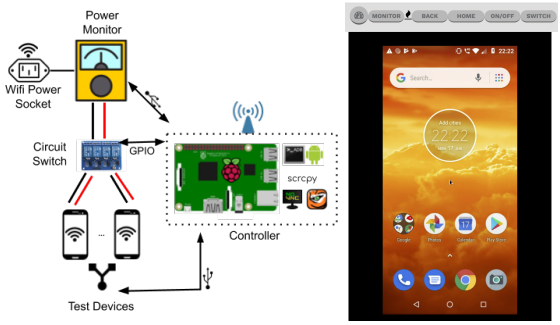
Measuring app performance in mobile systems has been popular in the research community [2, 3, 5, 7, 11]. While mobile OSs provide APIs and tools to estimate power consumption, previous works have shown that they tend to under or overestimate it [1]. Moreover, the sampling rate of the reported measurements is very low (device dependent, *e.g.,* 30 sec in Samsung Galaxy S9), resulting into missing information between samples. Other hardware-based solutions (*e.g.,* using Monsoon HV power monitor [8]) provide accurate results at high frequencies (*e.g.,* 5 kHz), but are expensive, installation is time consuming and requires technical skills in order to extract the smartphone's internal battery controller and by-pass the connected battery.

We present a distributed platform for high-accuracy energy measurements on Android and iOS devices. Inspired by PlanetLab [9], we developed a platform where members can both contribute and use remote resources (*e.g.,* one or more iOS / Android phones and a power monitor) in exchange of access to the hardware resources offered by other platform members. Experiments can be automated (*i.e.,* a script that automates some actions to the device) or user-based (*i.e.,* a user can physically hold and use the device or control it remotely via a web browser).

The system infrastructure (Figure 1) consists of a cloud-based *access server*, and a series of distributed *vantage points*. The access server is responsible for managing the vantage points and schedule experiments on them. We built the access server atop of Jenkins [6] which enables an end-to-end test pipeline while supporting multiple users and concurrent timed session.

The vantage point is managed by a Raspberry Pi [10] which runs our software to enable remote testing, *e.g.,* SSH channel with the access server and *device mirroring* [4] which provides full remote control of test devices, via the browser. Next, a circuit switch connects to the Raspberry Pi's General-Purpose Input/Output (GPIO) interface and allows a programmatic selection of the phone that needs to be measured by the power monitor. The test devices also connect to the Raspberry Pi via USB, WiFi, and Bluetooth, for automation/instrumentation purpose.

In the talk, we will discuss the capabilities of our platform and the challenges we faced for supporting both Android and iOS platforms. We will present preliminary results on the accuracy of battery reporting while performing mobile-related tasks, along with some system benchmarking. We will also demonstrate how our system can be used by other researchers to investigate an example research question, relevant to MobiUK's community.



(a) Vantage point design (b) GUI

Figure 1: System Infrastructure

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