**Android Energy Manager [or better title]**

A user friendly energy tool for Android Phones

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*Index Terms*—Component, formatting, style, styling, insert. *(key words)*

# Introduction *(Heading 1)*

The use of mobile devices has now permeated our everyday lives. Cellular phones and other devices are merely an extension of the self. They are used and relied upon for everyday tasks such as phone calls, emails, text message, social media, web browsing and more. As the usage of smartphones increases, the battery life of phones has began to decrease. In the days of flip phones, devices could be used for multiple days without charging. However, now, most devices don’t last more than 6-8 hours.

The source of the loss in battery life is two-fold. First, the increased usage of the cell phone will naturally cause some loss in battery life. It is unrealistic to expect that we use a device much more and still have it maintain the same battery life. Second is the rise of power-hungry mobile applications. Mobile applications are consuming increasingly more of the phone’s energy.

There are two general classes of applications that consume disproportionally large amounts of energy. The nature of some applications is such that they must use large amounts of energy. Applications such as maps that rely heavily on real-time sensor data will naturally and inevitably use more battery. Other applications, such as Facebook, run continuously in the background polling for updates or user information, unbeknownst to the user, draining battery significantly. The second class is particular instances of applications that happen to consume more energy. This can sometimes be due to a faulty launch in the application and a simple restart is enough to cure the issue. Other times, the software itself has a bug.

Distinguishing between these two cases is difficult for a computer to do given that it has no information about the baseline of how much energy the app is expected to consume. However, this information is often intuitive to the user. It is simple for the user to determine whether the app is a naturally energy intensive application or it is consuming unexpected amounts of energy. Therefore, Android Energy Manager delegates the task of determining these thresholds to the user. The choice of this approach will be discussed in future work.

# Related Work

Many research projects have taken various approaches to monitoring application energy usage. Carat, by Oliner et al. takes a black-box approach at diagnosing energy-usage. Pathak et al. took a fine-grained approach to diagnosing energy usage, and Balasubramanium et al use native instrumenting tools to measure mobile device energy consumption.

In Energy Consumption in Mobile Phones, the native Nokia Energy Profiler was used to sample the energy consumed every 250 milliseconds. The application reported consumption at 95% confidence. Obvious drawbacks to the method are that this only works on Nokia phones. Furthermore, even though the data is fine-grained and accurate, users have reported that interpreting the data presented by the application is difficult to interpret and act upon. This is because the energy profiler only estimates energy consumption device level. It does not profile at the application level.

Pathak et al take the opposite approach in Fine Grained Energy Accounting on Smartphones with Eprof. They instrument the code in order to fully understand how energy is consumed at the sub-application level. However, this method is not portable for our application since it requires the source of applications. Furthermore, to measure the energy of a new app requires work for each additional app, which does not allow for universal use.

In Carat, Oliner et all take a blackbox approach to measuring app energy consumption at the application level. The blackbox approach, which does not require knowledge about the application, allows for the app to be used universally. To diagnose energy hogs and energy bugs, the application measures system wide energy usage as well as all processes running and constructs a graph representing the data. It compares many such graphs from various devices to detect apps as energy hogs (which consume disproportionately high energy across devices) and energy bugs (a particular instance of the application is consuming more energy than others) and reports it to the user. However, Carat’s implementation fails to distinguish between applications that should use more energy and those that do not. For example, Carat detects a map application as a hog, even though, it should naturally use more power.

[Insert Application Name Here] uses various aspects of the above implementations in order to allow the user to manage the energy consumption at the application level in order to extend the device lifetime.

# Design

Explain the choices of this paper

User defined thresholds

Simple selection

Hourly detection and user notification (android does not give access killing apps immediately + more user defined control so apps aren’t killed when they are undergoing some desired behavior)

# Measuring Energy

Cpu usage is highly proportional to energy usage.

V. Evaluation

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The word “data” is plural, not singular.

The subscript for the permeability of vacuum **0, and other common scientific constants, is zero with subscript formatting, not a lowercase letter “o”.

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A graph within a graph is an “inset”, not an “insert”. The word alternatively is preferred to the word “alternately” (unless you really mean something that alternates).

Do not use the word “essentially” to mean “approximately” or “effectively”.

In your paper title, if the words “that uses” can accurately replace the word “using”, capitalize the “u”; if not, keep using lower-cased.

Be aware of the different meanings of the homophones “affect” and “effect”, “complement” and “compliment”, “discreet” and “discrete”, “principal” and “principle”.

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