COMP4336/9336 Lab 6

Energy measurement

Lab Objectives

- Learn how to read the statistic of the battery of mobile phones such as current level of charge, charging method, etc.
- Learn how to measure the energy consumed by component of mobile phones such as CPU, GPS, etc.
- Learn how to measure the energy consumption of a specific application.
- Learn about some useful software/hardware in energy measurement of mobile devices.

Preparation

- **Overview**
  - Battery life is an important factor in providing excellent user experience for smartphones and tablet devices. These devices are intended to last well over 10 hours in normal operation mode and days, in standby mode on a single battery charge.

  - Understanding power consumption of a device while running an application will help application developer make appropriate software design choices to minimize device power consumption. This note discusses techniques to obtain power data while an application is running.

  - Android operating system provides a number of power related performance data in the /sys/class/power_supply/battery/uevent datafile1. The *uevent datafile* is updated by the battery device driver in Android. The frequency of update can vary from every hundredth of a second to as long as 30-40 seconds. The amount of information includes in these data files varies with different devices.

    More details:
    http://developer.android.com/training/monitoring-device-state/battery-monitoring.html

    http://developer.android.com/training/monitoring-device-state/battery-monitoring.html#MonitorChargeState

- **Android classes and methods:**

  - *BatteryManager Class*: The *BatteryManager* class contains strings and constants. For example, when you are going to charge the battery via USB port, the amount of BATTERY_PLUGGED_USB would be 2. *BatteryManager* broadcasts all battery and charging details in a sticky Intent that called ACTION_BATTERY_CHANGED Intent.
    More details:
    http://developer.android.com/reference/android/os/BatteryManager.html

- **Some useful notes and codes:**
  - *Take required permissions*: You need to add some privileges to the *Manifest File* in order to allow the application access to the Battery details:

    ```
    <action android:name="android.intent.action.ACTION_POWER_CONNECTED"/>
    <action android:name="android.intent.action.ACTION_POWER_DISCONNECTED"/>
    ```

  - *Registering an appropriate Intent:* In order to get the battery details you have to register aforementioned Intent with null receiver as shown in the next snippet:

    ```
    Intent batteryStatus ;
    IntentFilter ifilter = new IntentFilter(Intent.ACTION_BATTERY_CHANGED);
    batteryStatus = this.registerReceiver(null, ifilter);
    ```

  - *Getting battery level:* You can find the current battery charge by extracting the current battery level and scale from the battery status intent as shown here:
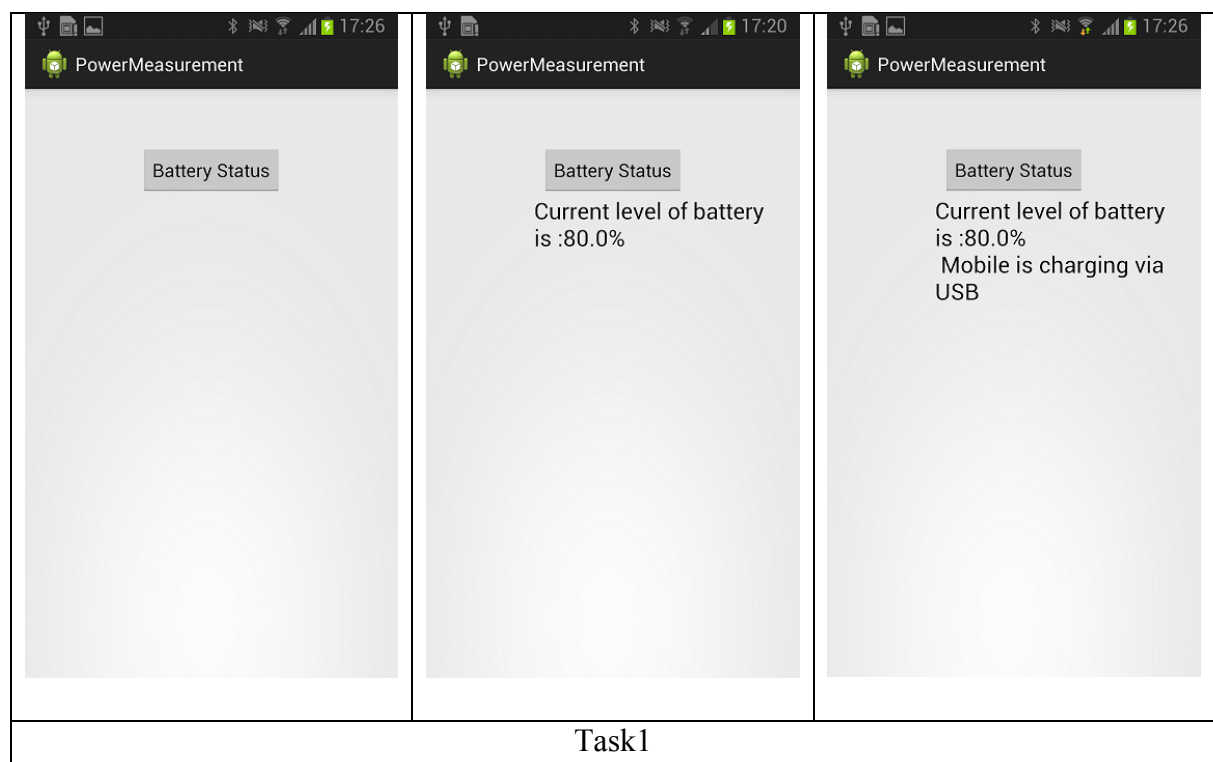
    ```
    int level = batteryStatus.getIntExtra(BatteryManager.EXTRA_LEVEL, -1);
    int scale = batteryStatus.getIntExtra(BatteryManager.EXTRA_SCALE, -1);

    float batteryPct = level / (float)scale;
    ```

Lab Tasks

Task1 : Check the status of phone battery (0.25 Marks)
Develop an android application to check the status of the battery and display the current level of charge. It also should be able to check whether mobile is charging or not and what is the charging method (USB/AC/Wireless)
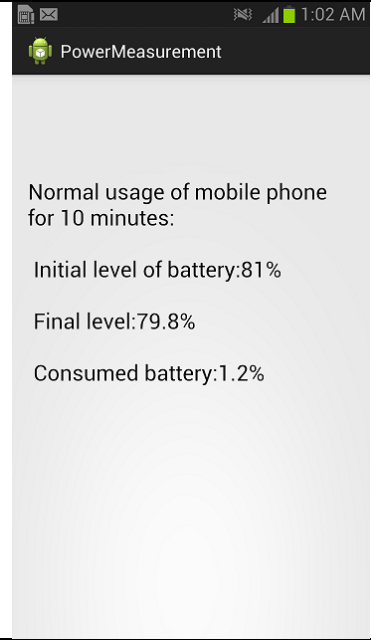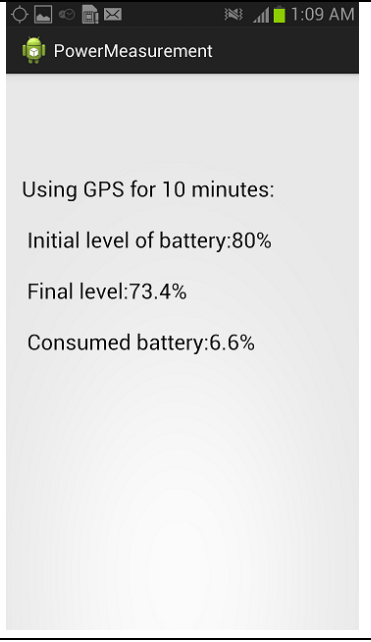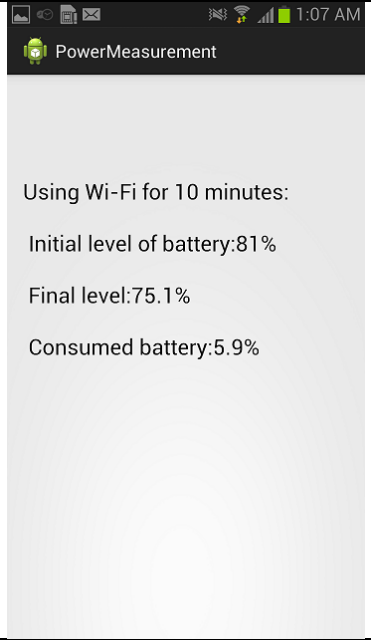

Task1

Task2: Battery consumption of GPS/ Wi-Fi (0.5 Marks)
Develop an android application to capture the drop in the level of the battery during using phone without GPS/Wi-Fi, using only GPS and using only Wi-Fi for 10 minutes.

Note: In order to capture the battery drop in normal usage of phone, first you have to disable GPS/Wi-Fi interfaces then leave the phone for 10 minutes. The battery level should be captured before and after this period.
Note: For GPS, first enable GPS and run your program for 10 minutes second to capture the drop in the battery level. During this period, you have to work with GPS. For example, you can run lab3(task3) program in the background. You can do the same process for Wi-Fi.

1:02 AM PowerMeasurement — Normal usage of mobile phone for 10 minutes: Initial level of battery:81% Final level:79.8% Consumed battery:1.2% **1:09 AM** PowerMeasurement — Using GPS for 10 minutes: Initial level of battery:80% Final level:73.4% Consumed battery:6.6% **1:07 AM** PowerMeasurement — Using Wi-Fi for 10 minutes: Initial level of battery:81% Final level:75.1% Consumed battery:5.9%
Task2 (note: numbers are not realistic)

Task3: Measuring the energy consumption for a specific application via NI hardware (0.25 Marks)

In this lab, you will first observe a demo of a National Instrument (NI) power measurement hardware. This demo will explain you how this instrument is used for power measurement. The following research article explains an example use of this instrument to measure power consumption of different modes text input in Android smartphones.

http://www.cse.unsw.edu.au/~mahbub/PDF_Publications/percom15_phone_cr.pdf

Now let us assume that you have a NI hardware and related software to measure the power consumption of a mobile phone every millisecond. How can you get the exact consumed power for a specific application in the mobile phone?

Note: The NI log all data on the computer in csv file.