Using Mobile Devices for Home Laboratories

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Smart Phones and Tablets: Real Data (not simulations)!

- Standard Internal Sensors:
  - Light,
  - proximity,
  - cameras,
  - microphones,
  - location (GPS, WiFi, cell tower, Bluetooth),
  - accelerometer,
  - magnetometer.

- Common: gyroscope, pressure, temperature, humidity.
Nokia Acceleration App (2008)

Car accelerating and braking.
Accelerometer App (iOS)

Airplane Takeoff

![Graph showing acceleration over time during airplane takeoff](image-url)
The Accelerometer Axes
Pendulum Data

Physics Toolbox Accelerometer

Maximum range: ±4.00
x: 0.10  y: 0.17  z: 0.98
Total G-Force = 1.00

G-Force

Time (s)

30 35 40 45 50

a b c d e

Vieyra Software
Physics Toolbox + Harmonic Motion App (Android)
Physics Toolbox + Magnetic Field App (Android)
Timing App (Android)
Vernier’s Video Physics
Bicycle Doppler Shift (source: 13784 Hz)
Sound Spectrogram
Real Data with Cell Phones and External Circuits

- Spectrometer (APS app + grating).
- Oscilloscope (app + probe).
- Temperature probe (ours-Android).
- Photo detector timing circuit (ours-Android).
- Ohmmeter (ours-Android).
- Force probe and Humidity meter (ours-Android).
- Voltmeter (ours-Android).
Optical SpectraSnap (APS)

For best results, crop and rotate your photo so the emission lines are aligned with the colors in the full spectrum. Go back to the calibrate screen to fine tune.

Compact Fluorescent Lights primarily rely on the discharge of mercury gas and various phosphors to produce light. When combined with other noble gases, mercury discharges can produce a variety of visible light.
Flir: Infrared Camera
LRC Circuit with Oscilloscope Probe
How to get Signals In and Out

Line-in Adapter

4-pole plug
(to Android / iOS device)

out L  out R  gnd  mic

C ~0.05uF

R ~10k

Mic / Guitar / Line-in (through variable resistor)

Gnd

Right Out

Left Out
Temperature with External Circuit

- 220 Ohm
- 10k Ohm
- 0.1 microF

Thermistor
Kickstarter: Thermodo
Photo-gates with External Circuits
Photo-gate Response
Photo-gates with External Circuits: Incline Plane
Force and Humidity (no app)
Voltage with External Circuit

[Image of a breadboard circuit with a voltmeter reading 1.872 V and 1.886 V, and a circuit diagram showing components such as a potentiometer, microphone, and a microcontroller with a formula for calculating f_out: \( f_{out} = \frac{V_{IN}}{2.09 \times \frac{R_S}{R_L} \times \frac{1}{R_1 C_1}} \).]
Crowd Sourced (real) Data Collection?
How to get an iSPEX?

Posted June 10th, 2013 by Frans.

We have organized two national iSPEX measurement days on 8 July and 5 September 2013. For these days about 10,000 iSPEX units have been distributed for the iPhone 4, 4s and 5. Thanks to the Academic Year Award and sponsoring by our partners, the iSPEX add on could be sold at €2,50 a piece (including shipping costs). This is a fraction of the production costs. Lung Foundation donors and subscribers to KIJK, Know How and Zo Zit Dat could order an iSPEX unit for free.

Currently, the iSPEX add-ons are sold out. The latest information on iSPEX can be found on this page and on our twitter feed and Facebook page.
Magnetic Anomalies
What is CrowdMag?

In CrowdMag project, we explore whether digital magnetometers built in modern mobile smartphones can be used as scientific instruments. With CrowdMag mobile apps, phones all around the world send magnetometer data to us. At our server, we check quality of the magnetic data and make data available to the public as aggregate maps and charts. We have two long-term goals:

1. Create near-real-time models of Earth’s time changing magnetic field by combining crowdsourced magnetic data with real-time solar wind data.
2. Map local magnetic noise sources (for e.g. power transformer and iron pipes) to improve accuracy of the magnetic navigation systems.

Success of CrowdMag project depends on participation by citizen scientists like you.

Why?

In this era of GPS and other geospatial technologies, what is the need of a compass? For a stationary device, GPS does not provide pointing direction. Satellite signals can be jammed or masked. For example, it is difficult to get GPS signals underwater. Earth's magnetic field (geomagnetic field) provides us an all-weather referencing system. Earth acts like a great spherical magnet and its magnetic field resembles, in general, the field generated by a dipole magnet (i.e., a straight magnet with a north and south pole) located at the center of Earth. The geomagnetic field has been observed and used for navigation
Total Exposure: 2 years, 141 days, 22 hours
Unique Devices: 208
Candidate Hits: 6,827,897

Network Map

National Ranking

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<th>Rank</th>
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Real data collection with mobile devices.

This is a clearing house site of physics experiments that use cell phones or tablets to collect and analyze real data. Some of these ideas are published, some not. Links to more information about each experiment are also included.

We consider this list to be a collaborative project. If you find other useful ways to use cell phones for real data collect, please lets us know and we will add you as a member of this group. Contact Kyle Forinash or Ray Wisman for suggestions or comments.

Recopilación de datos actuales con los dispositivos móviles.

Esta es un sitio de intercambio de información de los experimentos de...
Using Mobile Devices for Home Laboratories.

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https://mobilescience.wikispaces.com/