

European Network on New Sensing Technologies for Air Pollution Control and
Environmental Sustainability - *EuNetAir*
COST Action TD1105

CHALLENGES FOR ENVIRONMENTAL INFORMATION SERVICES RESULTING FROM SENSORS INTEGRATED TO SMARTPHONES

Kostas Karatzas

Informatics Applications and Systems – Environmental Informatics Research Group

Dept. of Mechanical Engineering

Aristotle University of Thessaloniki, Greece

kkara@eng.auth.gr, <http://isag.meng.auth.gr>

Contents

- Smartphone embedded sensors
- Data format
- Resolution aspects
- Data analysis
- The QoL service paradigm
- Conclusions

Smartphone embedded sensors

Sensor	Sensor event data	Units of measure	Data description
TYPE_AMBIENT_TEMPERATURE	<code>event.values[0]</code>	°C	Ambient air temperature.
TYPE_LIGHT	<code>event.values[0]</code>	lx	Illuminance.
TYPE_PRESSURE	<code>event.values[0]</code>	hPa or mbar	Ambient air pressure.
TYPE_RELATIVE_HUMIDITY	<code>event.values[0]</code>	%	Ambient relative humidity.
TYPE_TEMPERATURE	<code>event.values[0]</code>	°C	Device temperature. ¹

¹ Implementations vary from device to device. This sensor was deprecated in Android 4.0 (API Level 14).

“Standard” Android sensors

Data formats

Manually Reported	"not": "Tweet length note si what I am", "not_age": "4123123", "prec": "1231.13", "prec_age": "13243423211234300", "doo": "indoors", "doo_age": "23413232432",	not not_age prec prec_age doo doo_age	note note_age precipitation precipitation_age doors doors_age	manually added note time before the reading that the not was taken (typically a couple of seconds) field to contain data from manual reports, to be configured age of the above (i.e. amount of time in ms between the reading of pressure being manual field for reporting wr "indoors", "outdoors", "" age of above
Battery variables	"bat_tem": "", "bat_sts": "3", "bat_vol": "6700", "bat_plg": "2", "bat_lvl": "87", "bat_hlt": "3", "bat_tem_acc": "", "bat_tem_age": "",	bat_tem bat_sts bat_vol bat_plg bat_lvl bat_hlt bat_tem_acc bat_tem_age	batt_temp batt_status batt_vol batt_plugged batt_level batt_health batt_temp_acc batt_temp_age	battery temp in deci-degrees C (degr -998 battery status 2:charging, 3:dischargi -998 battery voltage milli Volts -998 battery plugged status 4:plugged wireless, 1: -998 battery level seems to be percentag -998 battery health 1:unknown, 2:good, 3 -998 accuracy field (as of 24/4/2013 no plans for anything here, but it may be added) age of all the above battery fields
Ambient temperature	"amb_tem": "22.3", "amb_tem_acc": "2.1", "amb_tem_age": "423167",	amb_tem amb_tem_acc amb_tem_age	amb_temp amb_temp_acc amb_temp_age	ambient temperature from phones that have one accuracy of above age of above

There is more information than expected!

Resolution aspects

```
"row_tim": "13231231232311",
```

Time in miliseconds (from 01 Jan 1970)

"lat": "52.32",	lat	lat	latitude
"lng": "123.3333",	lng	lng	longitude
"loc_src": "GPS",	loc_src	loc_src	location source
"loc_acc": "55",	loc_acc	loc_acc	location accuracy
"loc_spe": "12.1",	loc_spe	loc_speed	location speed
"loc_alt": "22.4",	loc_alt	loc_alt	location altitude
"loc_alt_src": "GOOG",	loc_alt_src	loc_alt_src	source of location altitude (ei GOOG, "" for GPS)
"loc_bea": "1.2363",	loc_bea	loc_bearing	bearing
"loc_age": "1326785",	loc_age	loc_age	age of location fix
"loc_sat": "2",	loc_sat	loc_satellites	nr of satellites used for fix, if available

Location: accuracy



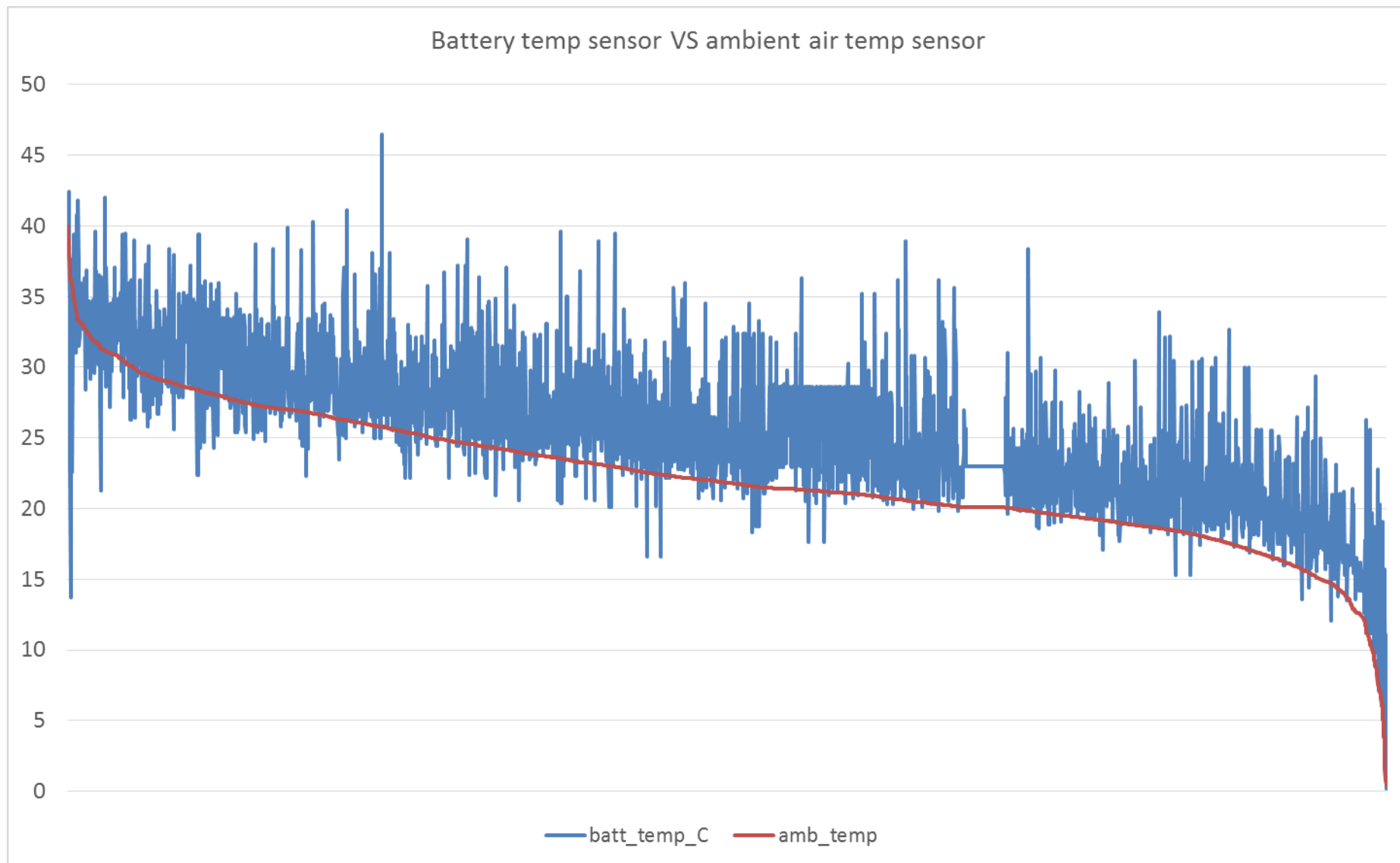
Data source



A freely available Android app and a development team sharing collected data

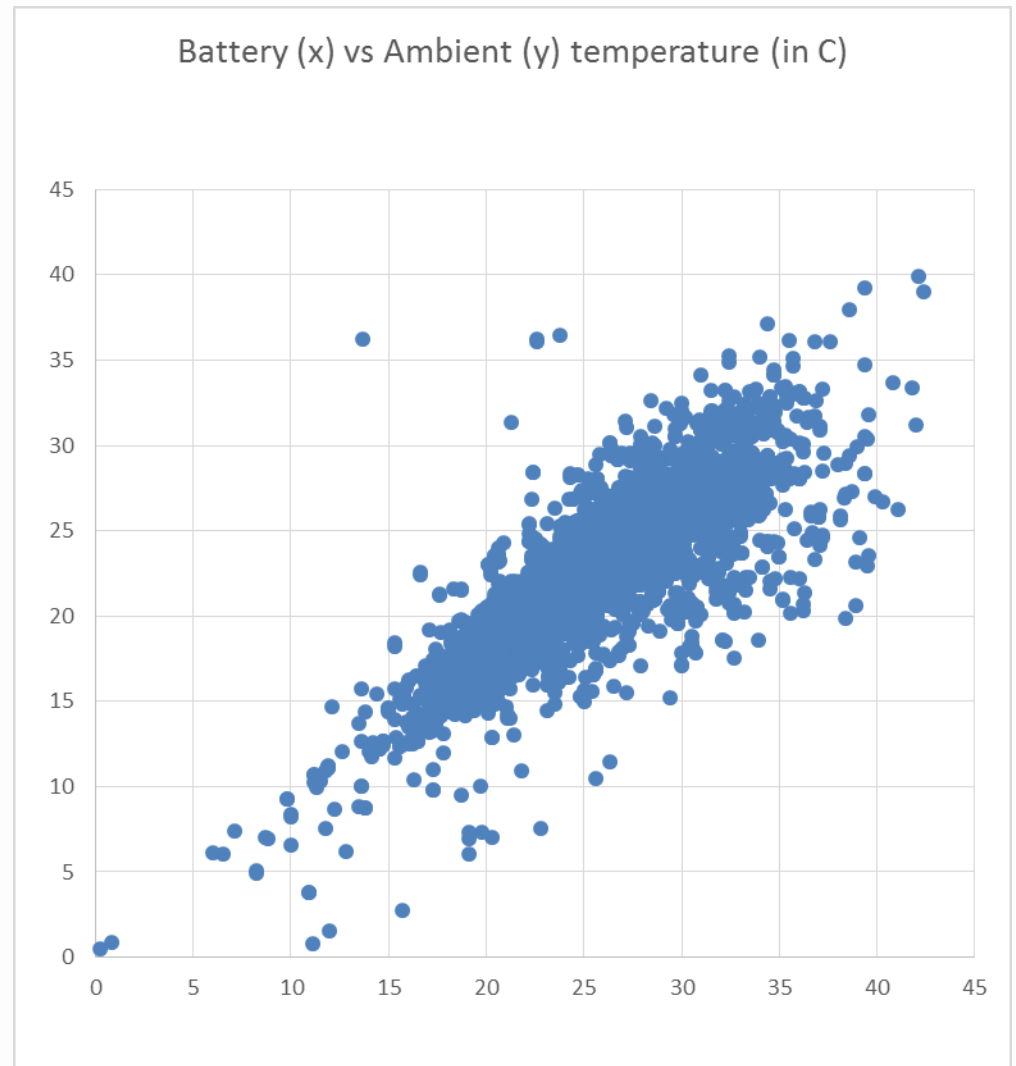
- Various smartphone manufacturers
- Battery: thermistor sensor delivering battery temperature reading to the OS
- Ambient: classic temperature microsensor

Data analysis

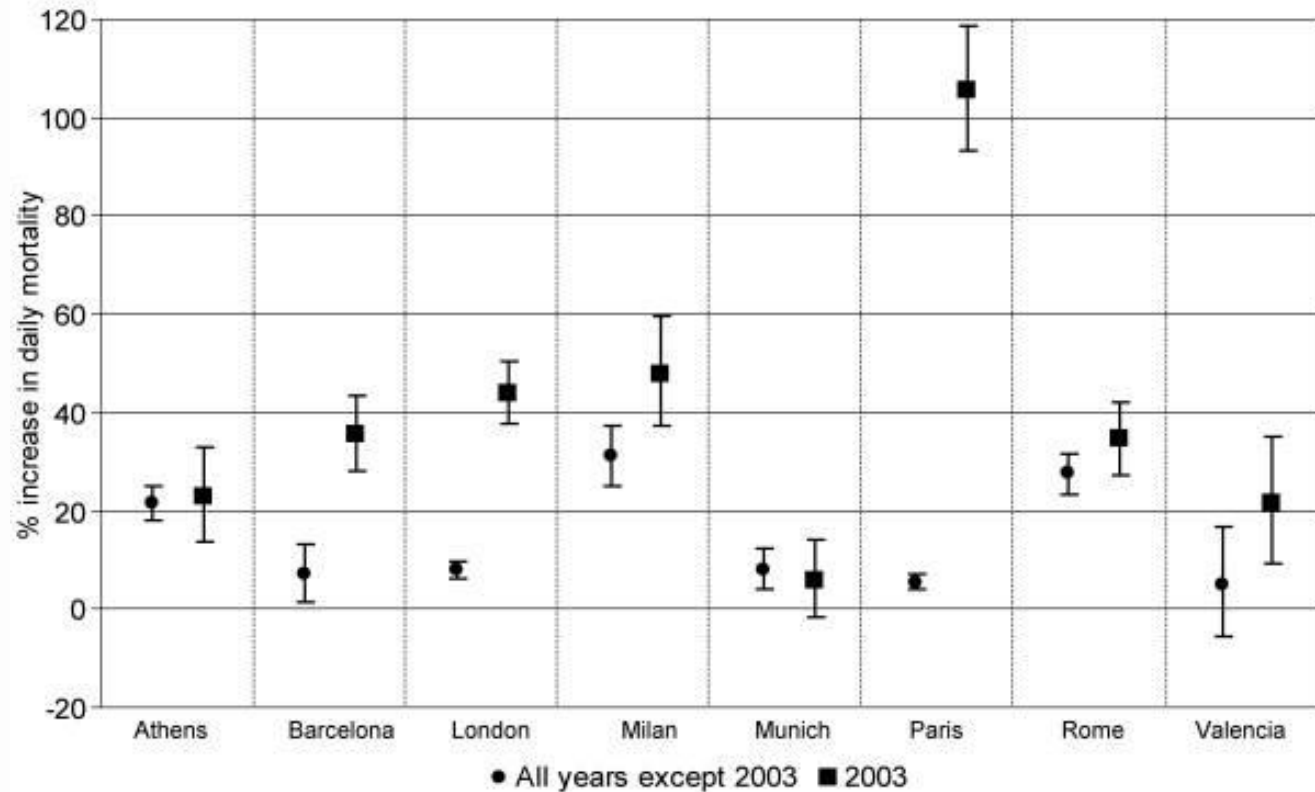


Data analysis

- Battery well in line with microsensor (can “duplicate” it’s behavior?)



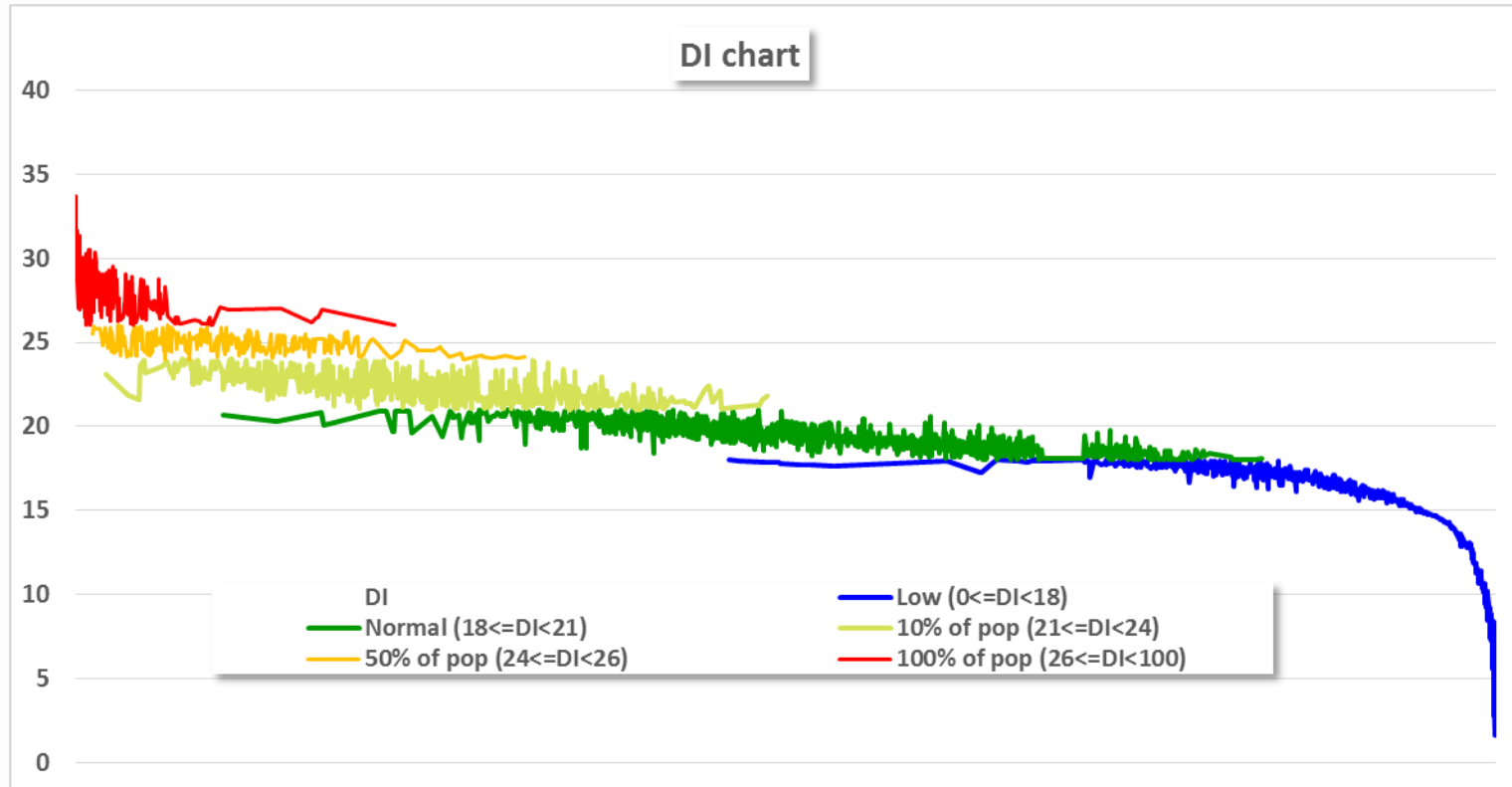
The QoL service paradigm: the DI



City-specific estimates of the effect of heat-waves on daily mortality (% increase and 90% CI) during summer 2003 and in other years

(Laadi et al., 2011, <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3279432/>)

The QoL service paradigm



$$DI = T - 0.55 * (1 - 0.01 * RH) * (T - 14.5)$$

Conclusions

- Smartphone embedded microsensors report data with a high temporal and spatial resolution
- In-built system sensors can be combined with embedded microsensors to increase the accuracy and coverage of environmental monitoring
- QoL information services can use embedded sensor data as raw material for smart, personalized service provision

Thank you!