A development of mobile monitoring system for urban climatology

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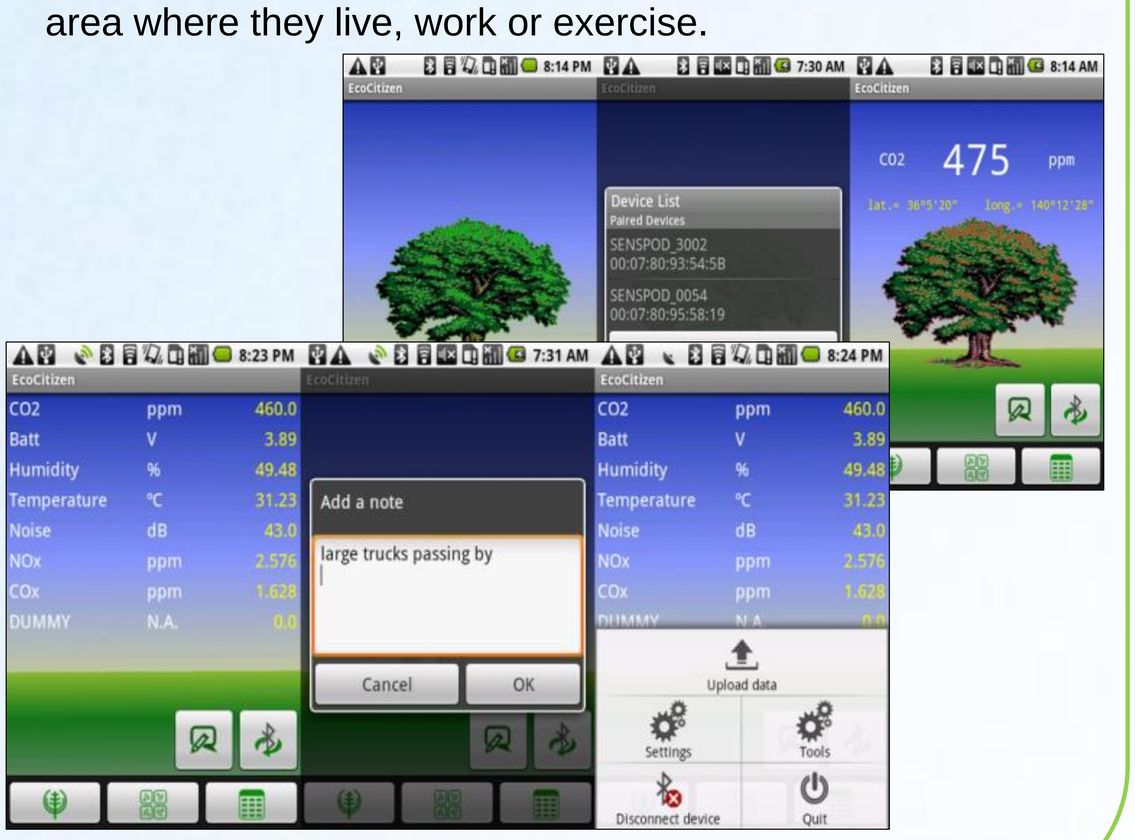
Introduction

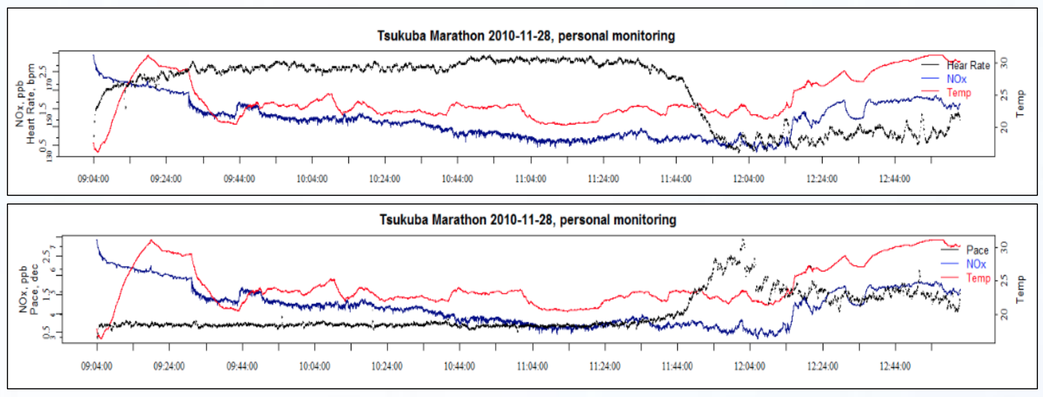
- We developed a real-time mobile monitoring system on air quality and thermal environment at the city block scale.
- This system helps designing the city blocks to locally improve outdoor comfort and provides access to a high resolution spatio-temporal environmental database, which includes information on the fine-scale outdoor thermal environment, air pollution, magnetic field intensity, etc.
- Based on a citizen participation approach, this system provides an opportunity for citizens to collect data in the area where they live, work or exercise.



Application on the Android system

Eco-Monitoring at Tsukuba Marathon and Runner's Performance

- The experiment was hold in November 2010 in Tsukuba-city with one marathon runner.
- We inquired the participant to measure NOx and other indices along his individual physiological parameters during the run.
- The parameters were recorded by the sensors and downloaded later-on to the server.
- The data he collects can be used in the analysis of this relationship to improve our understanding of the causes that might affect his performance in the marathon.



Monitoring results at the Tsukuba Marathon

Monitoring results at the Tokyo Marathon (noise)

Tsukuba Center Air Quality Monitoring

- We conducted an experiment to validate our system in April 2012 in Tsukuba city with the help of paid participants. Details of the experiment are as follows;

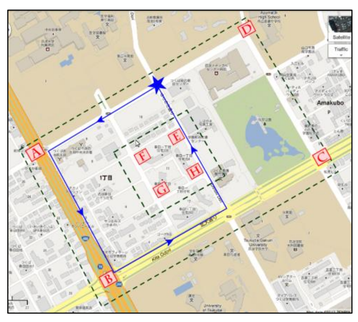
Duration of the experiment: from 21 to 25 of April 2012
Area: Tsukuba Center, between Gakuen-Nishi Odori and Kita Odori
Time: morning (8:00-11:00), afternoon (15:00-18:00)
Sessions: morning (starts at 8:00, 9:00, and 10:00), afternoon (starts at 15:00, 16:00, and 17:00)
Duration of one session: ~30 minutes
Number of participants: 20
Age of participants: from 20 to 65 y. o.

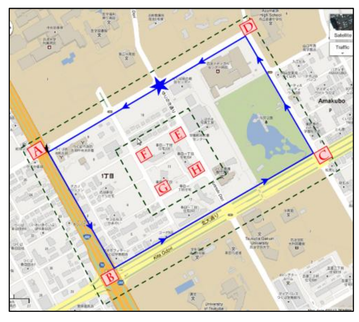
Example of devices (left: Eco-sensors, right: BioHarness sensor)

The measured parameters

Devices	Collected Environmental Parameters	N of devices	Company
CO_2 sensors	CO_2, temperature, humidity	6	Sensaris
Eco-sensors	COx, NOx, noise, temperature, humidity	6	Sensaris
UV and ozone sensors	UV, ozone, temperature and humidity	5	Sensaris
RemPod Geigers	radioactivity	2	Sensaris
BioHarness sensors	ECG, heart rate (were positioned just below the chest muscles)	9	Zephyr
Android phones	Used as data collectors and transmitters	5	HTC
Camera (Canon IXY, 14.1 mega pixels)	Photos were taken during the experiment	1	Canon

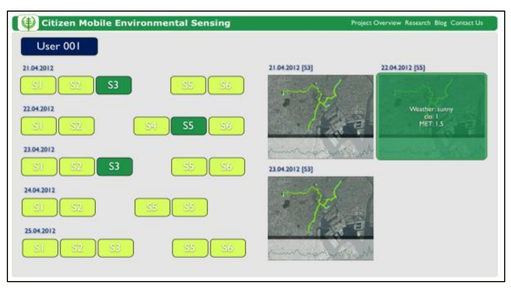
- The participants were provided with very light wearable devices (mobile phone, air pollution sensor and a body worn heart monitor) and were asked to walk along different routes (S1 to S9) in the area of interest in one session and then repeat the same route patterns on the next 4 consecutive days.
- We used the commercial devices from Sensaris and Zephyr companies; however, our system is not tide-up to a particular company.
- Any sensors that have a Bluetooth capability can be used in this project.





Example of route maps for monitoring around the Matsumi Park (in cases of S1, S2)

Participants attaching sensors



Monitoring results accumulated in the server

Tools used in the experiment:

- EcoMobileCitizen Map: http://www.ecomobilecitizen.com
- EcoMobileCitizen Android App: http://blog.ecomobilecitizen.com/android/

References:
Cordova-Lopez *et al*., Online vehicle and atmospheric pollution monitoring using GIS and wireless sensor networks, *J. Phys. Conference Series*, **76** (2007).

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