Offloading Cyber-Physical Tasks using Mobile Crowdsourcing

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Consortium MetroScope
Plate-forme APISENSE®
Enquête PRACTIC

www.metroscope.com
www.apisense.com
beta.apisense.fr/practic
How big is the Internet?

2014
- 3 billion Internet users
- 40% of the world’s population
- Exabytes of traffic per day
- 600 million websites

2020
- 6–7 billion Internet users
- ~ 60% of the world’s population
- Zetabytes of traffic per day
- IoT: 30 billion connected devices

Predictions by Cisco, Ericsson & other statistics organizations
Crowd & sensing
Crowd-sensing | kraʊdːsɛnsɪŋ |

Capability of lifting a (large) diffuse group of participants to delegate the task of retrieving trustable data from the field.

This includes:

● **Participatory sensing** involves the user in the sensing task (eg. surveys)
● **Opportunistic sensing** uses mobile sensors carried by the user (eg. smartphones)

**See also:** Ambient computing, mobile crowdsourcing
Applications to data visualisation

source: http://opensignal.com
Applications to crowdsourcing apps

source: http://fr.clicandwalk.com
Applications to real-time monitoring
Crowd-sensing challenges

Development cost

Software challenges
- Scalability
- Flexibility
- Security

Crosscutting challenges
- Privacy
- Energy

Task description → Worker recruitment → Task deployment

Worker rewarding → Data upload → Task execution

Challenges:
- Privacy
- Energy
- Scalability
- Flexibility
- Security
- Development cost
- Software challenges
- Crosscutting challenges

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Open crowd sensing platform:

- Flexible and customizable architecture
- Supporting various research communities
- Leveraging the deployment of crowd sensing tasks
How does it work?

1. Describe

2. Collect

- Open data
- Applications
- Visualizations
- Notifications
- Studies

3. Make sense!
How does it work?

A crowd sensing API (JavaScript)

```
1  $wifi.onScan({period : "1 min"}, function(event){
2    $trace.add(event)
3  })
4  $bluetooth.onScan({period : "1 min"}, function(event){
5    $trace.add(event)
6  })
```

Example of crowd sensing app
How does it work?
How does it work?

1. Describe
2. Collect
3. Make sense!

Privacy & Energy

- Open data
- Applications
- Visualizations
- Notifications
- Studies

Driving NYC
APISENSE® & PRACTIC
(PRAAtiques Culturelles et usages de l’Informatique Connectée)
sensors oriented towards the environment...
and towards the smartphone itself
**MetroScope: a multidisciplinary structure for the scientific Observation of the Internet**

- **Consortium**
  - Initiative by Inria of a consortium in 2012
  - Metroscope ([www.metroscope.org](http://www.metroscope.org))
  - Main partners: Inria, Université de Caen, AFNIC, RENATER, ARCEP, IMT, ENS/ENSSIB

- **Objectives**
  - Internet Observatory: create a large scale national observation platform
  - Computer Science: research new architectures/protocols to overcome current limitations/faults, propose future improvements
  - Social Science (SHS): Internet usages, cartography, influence on the society
PRACTIC & APISENSE®

- First project under Metroscope consortium

- Goal
  - Study the influence of mobile technologies on the society

- Approach
  - Deploy crowd-sensing campaigns (using APISENSE®)
Deployment of PRACTIC into APISENSE®

Campaign design
Composit method
- digital methods (crowd-sensing)
- digitized methods (online survey)
- qualitative methods (interviews)

Time-stamped measures (no content)
- screen activation
- network detection and performance
- calls / SMS
- applications
- battery
- device model and static measurements

Self-administered questionnaire (138Q)
- sociodemographics
- equipment / configuration
- cultural practices
- advertisment and privacy

Possibility of anonymous contacts
Script updates or requests for interviews
Deployment of PRACTIC into APISENSE®

1. Describe

2. Collect

High Security Laboratory

3. Make sense!

Dissemination of the application

Privacy Statement (privacy)

+ Display of personal data (incentive)

Open data
Applications
Visualizations
Notifications
Studies
Incentive: the model of a free service between Quantified-self and Mydata.
Data collection "in the wild"
Technical determinations of uses

Battery limits, network performance, screen size, software stability... are constraints that define our relation to the Internet

Frequency and duration of sessions on a smartphone and a tablet
(occurrences of the number of sessions according to 3 levels of duration)
Observing the rhythms of lifestyle from smartphones
social embeddedness of the uses and technical organization of society

Emergence of temporal patterns:
Smartphone sessions according to the hour of the day
Does metrology produce a "truer truth" in sociology?
Comparison of questionnaire and measurement on 4 simple questions

1. How much time per day do you use your smartphone?

2. How many applications do you use daily?

3. How many applications has your smartphone?

4. What are the first and second main uses of your smartphone?
Work in progress

Collaborating with scientists

- Mobility analysis (CEREMA, Microsoft)
- Climate monitoring (ULCO)
- Internet observatory (MetroScope)
- ...

Journées scientifiques INRIA, june 26th 2014
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