Sensors talk and humans sense
Part I

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PRESENTATION ABSTRACT

Smart city infrastructures provide unique opportunities for innovative applications developing and testing. Sensor city installations offer the ground for experimenting with user-oriented services, which at the same time can test and improve the infrastructure itself.

This lecture summarizes principles and methodologies for *bridging sensor measurements and social networks interactions*.

SEN2SOC experiment under the EU Smart Santander project (2nd call for experiments) infrastructure will be outlined and presented such that sensor to social reciprocities will be summarized. Social networks driven practices to communicate sensor measurements to the public (citizens, authorities, etc) will be highlighted. Future trends in the area will be discussed in the context of developing collective aware applications and services.
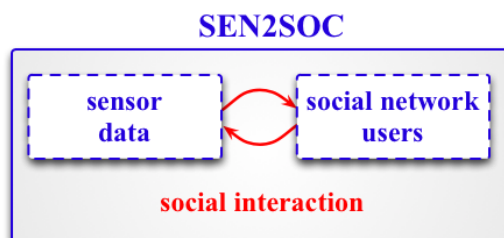
2

PRESENTATION OUTLINE

- SEN2SOC experiment: concept, motivation and idea;
- pre-experiment twitter analysis;
- SEN2SOC platform overview;
- SEN2SOC challenges and innovation;
- SEN2SOC audience and impact.

3

SEN2SOC concept

SEN2SOC: *bridging SENsor measurements and SOCial networks interactions via natural language generation for supporting smart city services*

❖ Internet of Things (IoT)

❖ smart city infrastructures

❖ smart living: "a mastered continuum of people, computers and things"

❖ **objective**: build apps that exploit IoT data streams (e.g., sensor data) and capture social pulse (e.g., Twitter)

SEN2SOC

sensor data · social network users · social interaction

4

SEN2SOC motivation

current Internet of Things (IoT) and Internet of Services (IoS) apps:
opportunities to test services/infrastructures
...*but* offer merely quantitative solutions (data from devices/sensors)

SEN2SOC: let's go *beyond quantitative outcomes*
...people are interested in qualitative human-oriented solutions

new design framework for integrating:
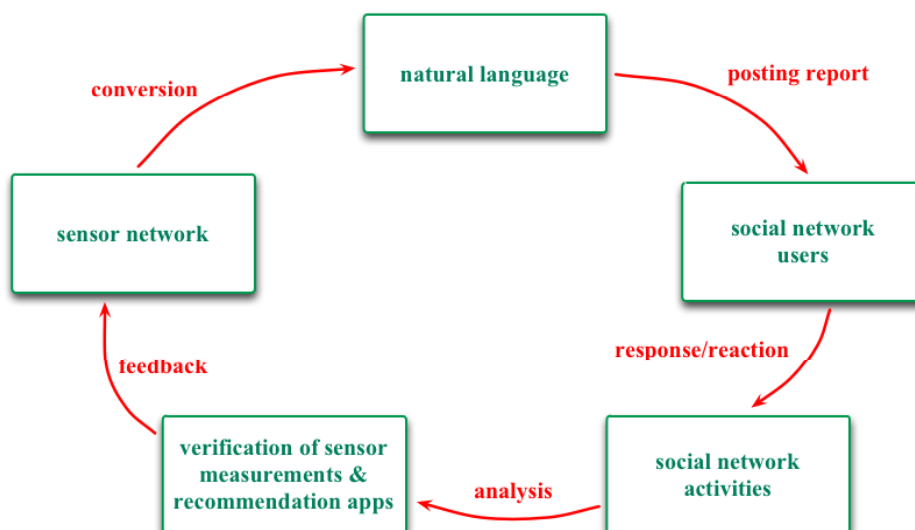quantitative sensor-generated data
+
qualitative human-generated data

5

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the SEN2SOC ... cycle

SEN2SOC = sensor-to-social reciprocal relationship

natural language

sensor network

social network users

verification of sensor measurements & recommendation apps

social network activities

conversion

posting report

feedback

response/reaction

analysis

6

todays SMART cities...

sensor networks: accurate measurements of physical parameters and phenomena (impact on citizens' life)

1. identify phenomena
(traffic congestion or atmospheric pollution at a particular area/time period)

2. take short-term actions
(inform/alert citizens and especially vulnerable social groups)

3. plan long-term actions
(understanding the progress of the phenomena and trying to address them)

7

...and SMART users

so far, smart sensor networks provide information about some parameters of a given phenomenon

OPEN QUESTIONS :
what are the effects on humans?

what knowledge can various social groups offer?

how can we utilize users' social response?

8

pre-EXPERIMENT: twitter activity on santander area

preliminary analysis: insight about the volume and content of tweets

25 days:
tweets (general geographic area of Santander)
& tweets (geolocated within Santander)

time duration: Oct-18 till Nov-12, 2012
total #tweets: 85067
#tweets with URLs: 5037 (~5%)
#tweets with hashtags: 9317 (~11%)
#tweets with geocoordinates: 43028 (~51%)

9

pre-EXPERIMENT: analysis and results (1 of 3)

textual analysis: titles of the pages that the identified URLs lead to

results: Santander citizens are very familiar with multimedia sharing social media

YouTube videos 18.6%

photo-sharing social network 12.4%

Instagram 10.9%

38% (of all shared URLs): Foursquare, Facebook, YouTube, Instagram

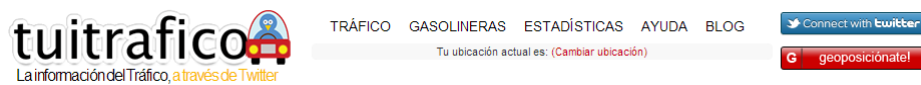10

pre-EXPERIMENT: analysis and results (2 of 3)

URLs that lead to pages about:

"Santander" 104 URLs

"Cantabria" 98 URLs

interest also for : Tuitrafico 20 URLs

Tuitrafico : a Twitter-based Web service that publishes incidents reported
by users, which are related to traffic, unusual weather conditions, etc.

tuitrafico
La información del Tráfico, a través de Twitter

TRÁFICO GASOLINERAS ESTADÍSTICAS AYUDA BLOG

Tu ubicación actual es: (Cambiar ubicación)

Connect with twitter

G geoposiciónate!

hashtag analysis results:

identified Santander user groups that support community-driven
political actions/campaigns (related to: European crisis) and
communicate their opinions via Twitter

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pre-EXPERIMENT: analysis and results (3 of 3)

textual analysis: tweets' text content

+

frequencies of: hashtags, terms, and URLs occurrences

events

interest in athletic events (e.g., football)
and art events (e.g., music concerts)

locations

frequency of terms:

"Santander" 1% of all tweets

"Cantabria" 0.5% of all tweets

topics

incident reporting:

"accident" 26 tweets

"traffic" 13 URLs

the SEN2SOC experiment

SEN2SOC will exploit and enhance SmartSantander testbed

1. utilize sensor measurements
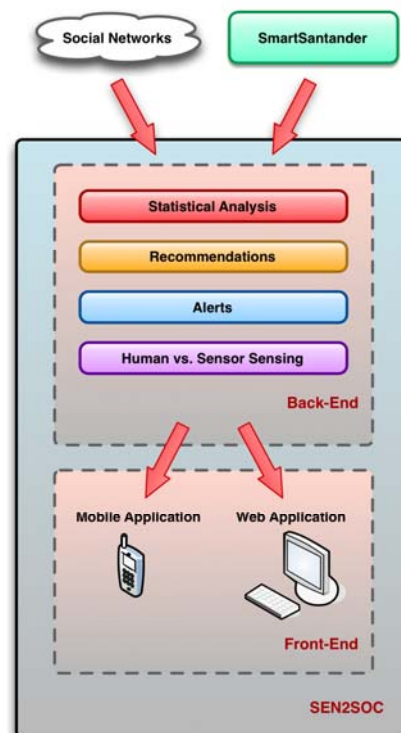interpreted in natural language postings & uploaded in social networks

2. follow social network activities around *sensor postings* and capture
"*human sensing*" and crowd observations
(traffic conditions, pollution, temperature, humidity, etc.)

Note: user info provided either by explicit postings or indirectly via social
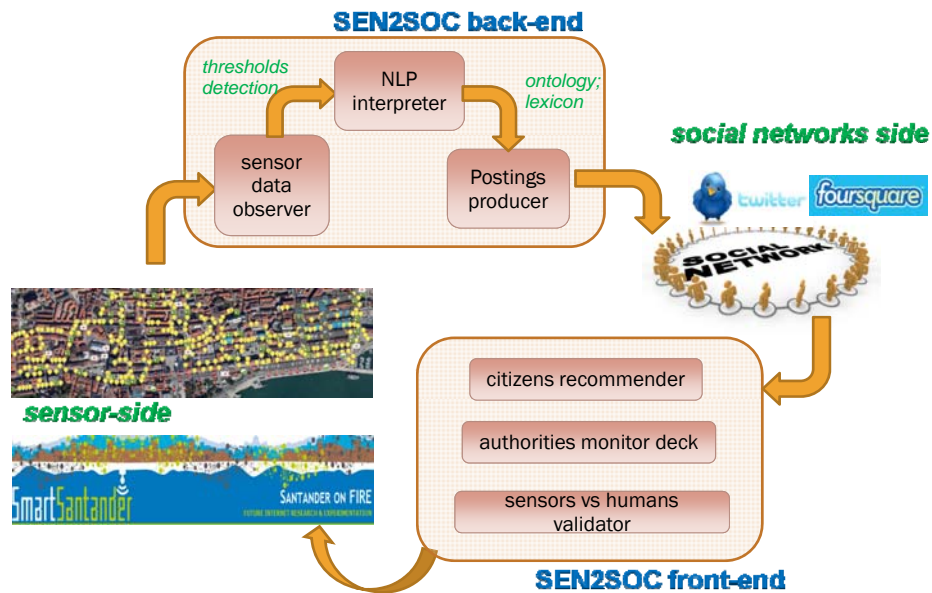network actions

13

SEN2SOC platform principles

1. *back-end module:* retrieves and analyzes sensor data, and detects extreme sensor measurements

2. *sensor-to-social interpretation mechanism:* generates alerts (social media postings or mobile application alert messages) when extreme environmental conditions are observed

3. *front-end module:* monitors and analyzes social networking activity and provides services to Santander citizens, visitors, and city authorities
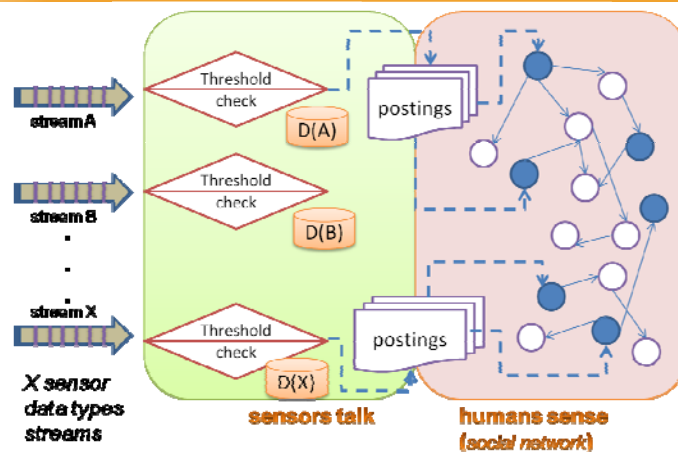
SEN2SOC platform overview
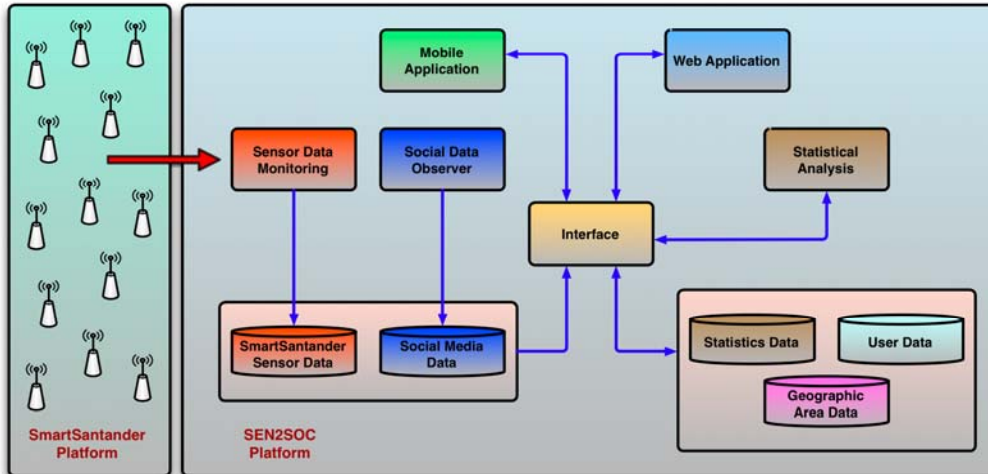

SEN2SOC innovation

SEN2SOC extends current SmartSantander sensor network with *"human-sensors"*

SmartSantander users: not only passive information consumers, but *active producers of information* themselves (info sharing)

16

SEN2SOC architecture

component-based architecture

SEN2SOC challenges

demanding data processing	improving the SmartSantander infrastructure	qualitative requirements
continuous sensor data recording	evaluation & validation of the SEN2SOC services	SEN2SOC user-friendly mobile and web apps
real-time processing	SmartSantander data availability	anonymity and privacy preservation
heterogeneous data (sensors, humans, apps)	measurement of SmartSantander platform responsiveness	collective activity capturing

SEN2SOC target audience (1 OF 3)

citizens & visitors

real-time adaptive recommendations:
- city navigation
- Points of Interest (POIs) visiting

sensor network: distance, CO level, noise level, public transport routes and schedules, free parking spots

social network: qualitative characterization (for weather, parking availability, pollution rates), POIs highly evaluated by users, tourists' observations

19

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SEN2SOC target audience (2 OF 3)

santander
Ayuntamiento

authorities

(city council, city's policy makers, emergency agencies, police, etc.)

city's major "variables" monitoring (e.g., noise, temperature, CO levels) via a user-friendly visualization interface

detection of problematic geographic areas (over-threshold sensor measurements)

broadcasting alert reports to citizens via social networks

20

SEN2SOC target audience (3 OF 3)

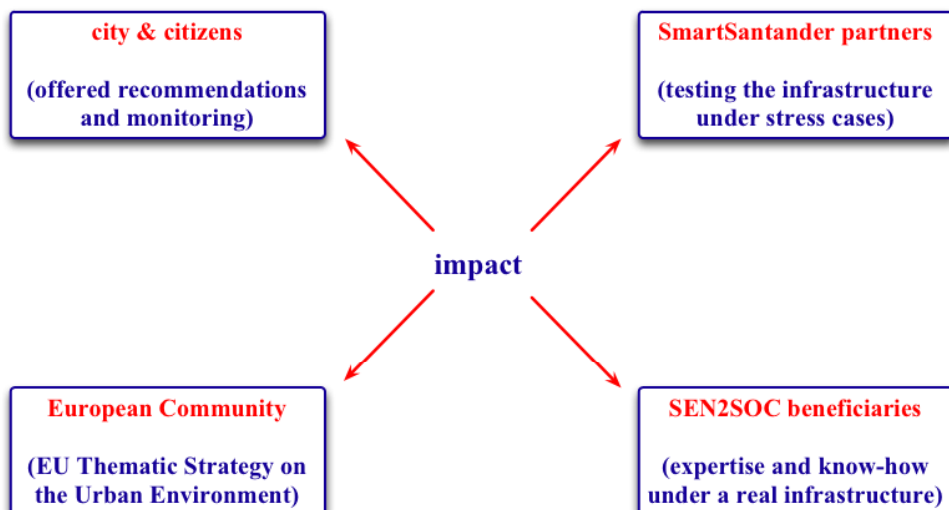*SmartSantander project consortium*

SEN2SOC experiment :

validates and complements sensor measurements

utilizes the public's responsiveness (opinions and reactions on sensor postings & alerts)

reveals areas of problematic sensor functionality or of poor measurements

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SEN2SOC impact

city & citizens

(offered recommendations and monitoring)

SmartSantander partners

(testing the infrastructure under stress cases)

impact

European Community

(EU Thematic Strategy on the Urban Environment)

SEN2SOC beneficiaries

(expertise and know-how under a real infrastructure)

OSWINDS group

OSWINDS
OPERATING SYSTEMS WEB/INTERNET DATA SOURCES MANAGEMENT

expertise on :

- identification of Web communities;

- social Web data analysis and mining;

- clustering and data management techniques;

- content delivery networks;

- recommendation techniques and methodologies.

23

SEN2SOC experiment TEAM

Partner	Name	Expertise/role
AUTH	Athena Vakali	Associate Professor; coordinator
	Christos Samaras	Post-doc; project manager
	Maria Giatsoglou	PhD student; social data analysis
	Despoina Chatzakou	PhD student; social data analysis
	Evangelos Chatzicharalampous	MSc student; data storage and alerts
	Christos Baros	MSc student; data storage and alerts
	Lefteris Angelis	Associate Professor; statistics coordination
	Stefanos Kapiris	Post MSc; statistics analysis
	Maria Papoutsoglou	Post MSc; statistics analysis
	Konstantinos Pachatouridis	Post MSc; mobile application and Interface
	Charalampos Tsipizidis	Undergraduate; Interface