Privacy-preserving Ubiquitous Social Mining via Modular and Compositional Virtual Sensors

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Motivation

Existing **social mining** practices threaten **social cohesion**

"surveillance has become increasingly privatized, commercialized and participatory", Julie E. Cohen

First Degree Price Discrimination Using Big Data

Benjamin Reed Shiller, Economics Department, Brandeis University
Research Question

How to design an open, decentralized, privacy-preserving & participatory system to provide ubiquitous social mining services engineered as public good

Social mining: the process of discovering information from data sensed in one or more social environments so that a social phenomenon is understood or a societal problem is tackled.
Approach

Introduction of a **modular** & **compositional** approach so that citizens **participate** during building lifecycle & later on

Why?

*Designing **extensible** & **reusable** social mining processes via compositional data flow of sensors **simplifies application development**

A design principle with a potential to **simplify crowd-sourcing activities** & **increase engagement** of building communities.
The Virtual Sensor Model

Input Streams → Virtual Sensor → Aggregator → Filter → Output Stream ↔ Environments

Environment
Portability – Internet of Things

We started in Android devices but…

… we move to iOS…

…and later on other embedded platforms, e.g. Arduino
Planetary Nervous System

- Accelerometer
- Light
- Temperature
- Humidity
- Gyroscope
- Proximity
- Battery
- Atm. Pressure
- Magnetic
- Noise
## Self-determination of Privacy

Two privacy levels!

1. **Local storage** – Filter of Android/iOS Sensor

2. **Sharing** – Sharing Sensor

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<th>Log</th>
<th>Share</th>
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Local & Global Analytics

Planetary Nervous Middleware System

Application Ecosystem

Global Analytics Sensor

Networking Environment

Local Analytics Sensor

Storage Environment

API Services
Local & Global Analytics

**Local analytics**: Building new virtual sensors, e.g. noise sensor

A data-driven API for social mining

**Global analytics**: Building decentralized aggregation services

DIAS – Dynamic Intelligent Aggregation Service

Applications

Real-time noise monitoring in Smart Cities

Privacy-preserving social networking and navigation
Demonstration
Computational Results

How to access the cost-effectiveness of the nervous system?

Emulation!

Data generation: 2 phone users, 20 virtual sensors, log every 5 sec, 10 days

What are the storage, retrieval and battery consumption costs?
Conclusions

Incremental development of social mining application

**Virtual sensors**: a promising design approach for building ubiquitous social mining services that are by design open, decentralized, privacy-preserving & participatory

**Modular and compositional approach**: stimulates engagement & innovation in crowd-sourcing activities

Performance evaluation confirms the feasibility of the introduced model
Join our Collective Vision!

Questions?

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https://github.com/mosgap/nervous