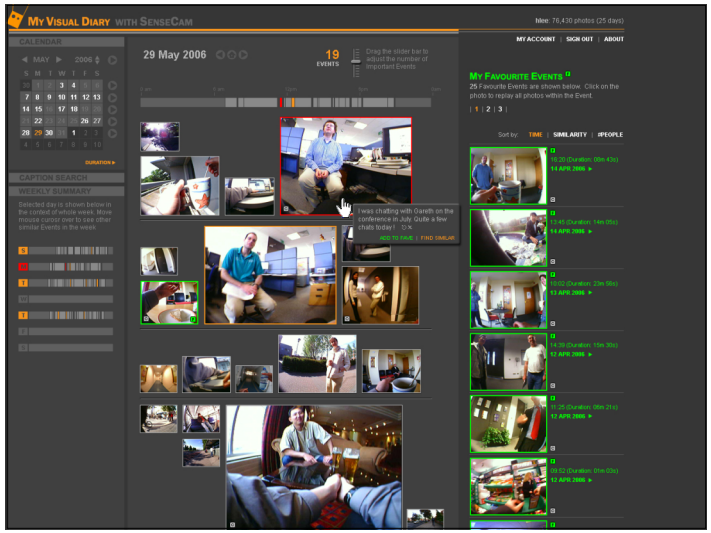
SenseCam and the Sensor Web

Alan F. Smeaton
CLARITY: Centre for Sensor Web Technologies
Dublin City University

Overview

- At SenseCam 2009 introduced our work on segmenting SC data into events, supporting event-based searching, event augmentation from web resources, processing SC data against (27) semantic 'concepts' and detecting objects in SC images;
- Now provide an update on some of these, and new developments.



SenseCam browser

- Event-based SenseCam browser re-engineered and on CodePlex since February, 250+ downloads.
- Provides basic event segmentation and event browsing.
- Even the UK elephant polo team, can use it !

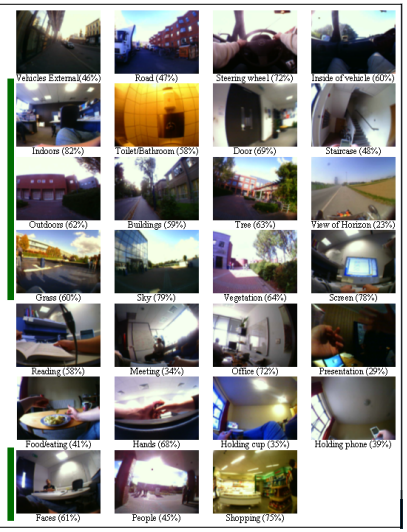
A. Concept Detection

27 “concepts” defined

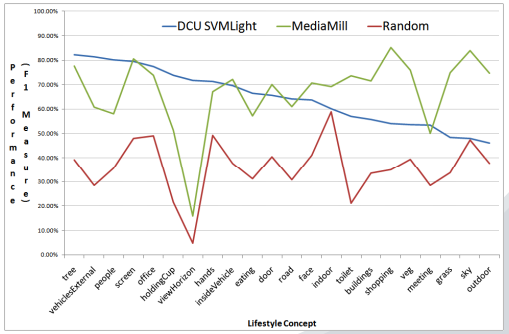
Outputs manually judged on ~95k images (5 users)

Automatic detection

Could profile Person X vs. Person Y distribution of concepts, or X vs. X over time to yield lifestyle analysis



CLARITY
clarity-centre.org



- Concept identification accuracy of our system (avg. 65%) vs. state of the art (68%)

User evaluation

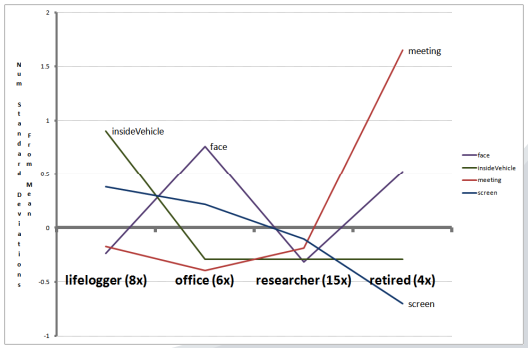
CLARITY
clarity-centre.org

- Working with U. Sheffield (Vaiva Kalnikaité)

Participant Group and (#)	Median # of Days of SenseCam data	Median # of Events per Day	Median # SenseCam Images per Day	Averaged SenseCam wear per Day
Office Workers (6)	7	19.5	1,599	6h 55m
Researchers (15)	8	20	1,640	7h 15m
Retired (4)	3.5	25.5	2,091	10h 30m
Regular lifeloggers (8)	42	18.5	1,517	10h 21m
Overall Averages	15.1	20.9	1,712	8h 45m

- 1.01 M minutes, 33 users, 4 categories

CLARITY
clarity-centre.org



- Time spent across a sample of 4 activities

- 20 most strongly co-occurring concepts.
- Can also do analysis of eating times, group concepts into activities.
- Re-defining the set of concepts to align with true activities.

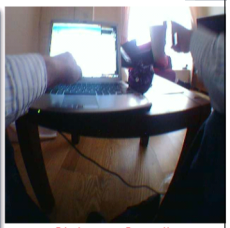
Trait 1	Trait 2	W
face	people	0.79
buildings	sky	0.77
sky	tree	0.74
buildings	tree	0.66
hands	indoor	0.65
indoor	people	0.65
buildings	outdoor	0.62
grass	veg	0.58
outdoor	sky	0.57
face	indoor	0.56
hands	people	0.55
tree	veg	0.54
grass	tree	0.53
hands	screen	0.53
face	hands	0.5
indoor	screen	0.49
outdoor	tree	0.48
grass	sky	0.48
office	screen	0.47
sky	veg	0.44

Consequences …

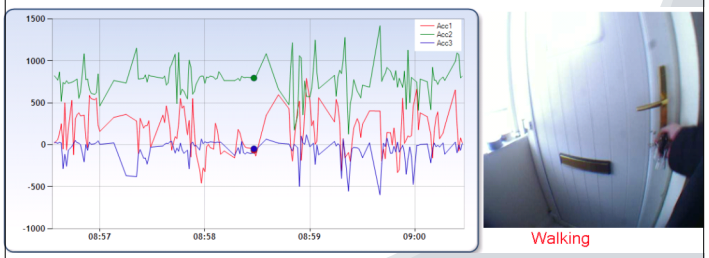
- Now starting work with ethnographers and others, on defining contexts (activities) when certain episodes happen … falls, or example.
- Also prospects for realising the identification of those lifestyle characteristics, within group, across group, individual, with re-defined (ontology) of concepts.

B. Activities from SC Data

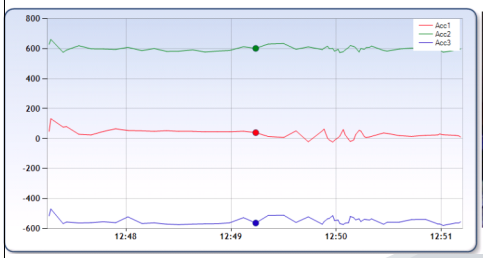
- We've analysed the SC accelerometer data with a view to 'learning' underlying human activities.
- Sitting, lying down, driving, walking …
- Built a training set, manual annotation.
- Used a SVM to train then test performance.



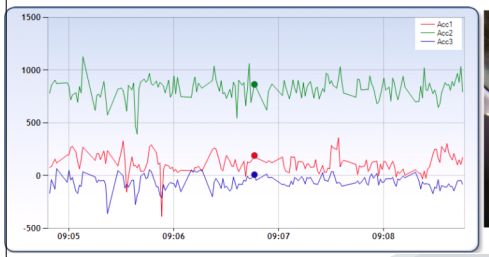
Sitting or Standing



Walking



Lying



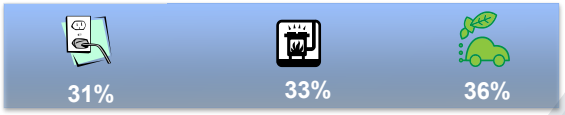
Driving

What can we do with it ?

- **Can use these categories as facet for retrieval, as a base for lifestyle analysis, or as a basis for carbon footprinting.**
- **Really fast to execute !**

C. Domestic Energy

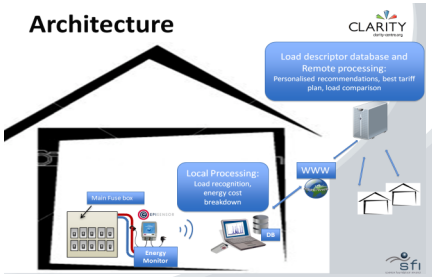
IRELAND's ENERGY-RELATED CO_2 EMISSIONS (SOURCE: SEAI)



- Smart energy metering projects springing up;
- Attractions of data collection, load-based tariffs, real time user feedback and management of peak demands;
- Also supports micro-generation, and energy trading using storage from EVs;
- Smart meter trials generate sensor readings;

Domestic Energy

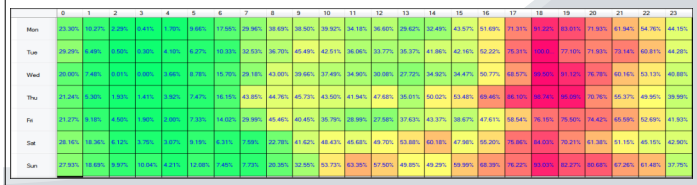
- So we built the following



Domestic Energy

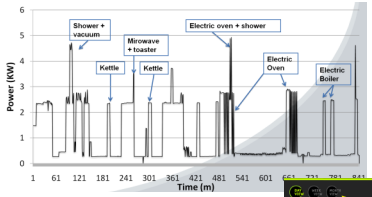
ZEM-30 Energy Monitor

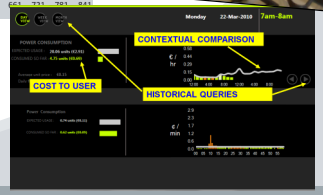
- Monitoring cuff placed on/around live line of mains supply
- Reports multiple power/current/voltage values every minute
- 15,840 sensor readings per house per day! 2 million/week in total
- Normal 5-7PM peak in electricity consumption



Domestic Energy

- Typical usage profile

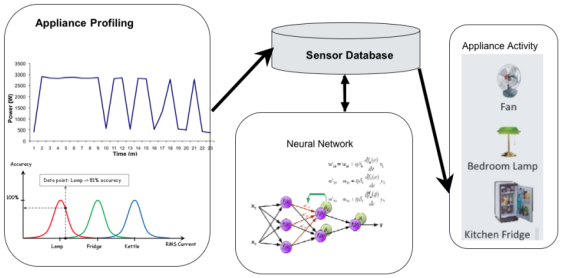




- Touchscreen for in-home display, passive visualisation

Domestic Energy

- Can also recognise (major) appliance usage



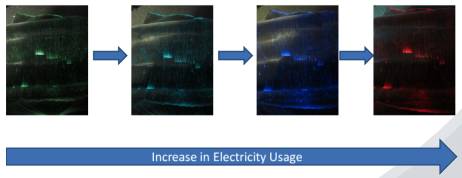
Domestic Energy

USE CASE: SHOWER USAGE

- 1 home, Sep-09 to Jul-10
- **3,391,443 sensor readings ...520 showers**
- Average duration = 8 minutes (min = 3 min, max = 27 min)
- 8am Tuesday morning is peak time

Domestic Energy

- **Developed ambient feedback through smart textiles**
  4-pin multi-colour LED, compare current vs. expected



- **What do people want, based on trials in homes ?**
  - (near)realtime feedback and warnings, in the longer term, life patterns and alerts
- **We're starting work with health monitoring, monitoring older people life patterns in their homes, based on energy metering.**

SenseCam +

- What's that got to do with SenseCam ?
- Smart meters will spread, now are easy to install, data can be used to enrich SenseCam data;
- SenseCam and a Smart Meter, gives much cross enrichment;
- Much of our work now focused on SenseCam + something, defining better contexts.