

Lifelogging: A New Challenge for Multimedia Information Management

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**SLIDE REMOVED FROM
ONLINE VERSION**

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Science Foundation Ireland

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Microsoft Research

... a talk about multimedia, multimodal lifelogging and how it offers a new opportunity and set of challenges for multimedia information management ...

Overview

- What is lifelogging and why bother
- Visual lifelogging, devices and SenseCam
- Our work on SC data management, events, event browsing and augmentation
- Further uses for lifelogging data
 - Activity Recognition
 - Diet Monitoring
 - Scene Detection
 - Trajectory Estimation
 - Incorporating Contextual Information
 - CO₂ Estimation
- Lifelogging - where next ?

Lifelogging

- Lifelogging is about digitally recording your daily life
- Such recording takes many forms, from written diaries to Twitter tweets, and our digital world greatly enables automatic lifelogging
- Most of what we do can be re-constructed with appropriate access to mobile phone records, computer network access records, credit card records, CCTV records, TV subscription records, in-car GPS records, and so on.
- In practice, access to these independent records happens only in cases of investigation, when we forensically re-construct a lifelog
- Lifelogging has become known as the term for self-recording, auto-biographical, sousveillance

Why lifelogging

Sometimes its for a reason

Work	e.g. security personnel, medical staff, etc.
Personal	e.g. diaries, etc. increasing interest in Carbon footprints and energy awareness

Sometimes Its medical

Early-stage sufferers of dementia/Alzheimers show results

Sometimes its for lifestyle analysis

Working with medical practitioners, behaviour analysts and marketing analysts

Sometimes its for posterity

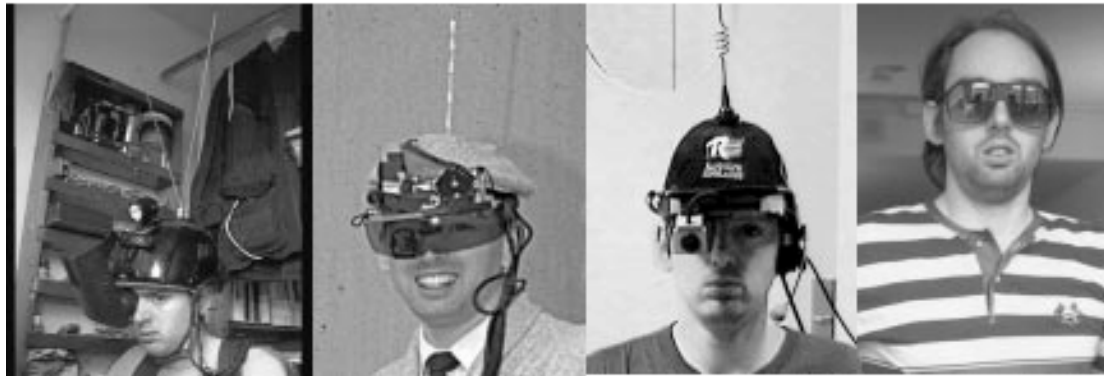
Recording vacations, family gatherings, social occasions

Sometimes its because we can

And we're not yet sure what we'll do with it e.g. MyLifeBits

Visual Lifelogging Devices

Much past research focus on miniaturising hardware and increasing battery-life + storage e.g. visual lifelogging domain



Steve Mann. Wearable computing: a first step toward personal imaging. *Computer*, 30:25–32, Feb 1997.

TIMELINE



Tano *et. al.* University of Electro-Communications, Tokyo, Japan



Microsoft Research
SenseCam

Steve Mann, U Toronto is a pioneer, trailblazer, geek, rights activist, who has become physically dependent on his Eyetap for vision, and has had this validated in court.

His technology is a camera and screen projection directly in front of his left eye.



Eyetap

By Self-assembled (Steve Mann)
Cost Variable, recommended to buy
Mann's book

**Video projection onto inside of Eyetap
glasses**

What about an OTS device re-purposed for visual lifelogging ?



Apple iPhone 3GS

Sensors GPS, Wifi, Accelerometer, Proximity sensor, Ambient light sensor, compass

... problem is that It looks like an iPhone !

Even worse than an iPhone ...



Android Developer Phone

Sensors GPS, Wifi, Accelerometer, Magnetic sensor, bluetooth, compass

... and worse again ...

Problem with these is that they are mobile phones, with add-ons, and always will. Not designed as lifelogging devices so inherent issues of battery and of storage capacity



Flip Mino HD

Sensors No other sensors

Another option ... but it needs a netbook in your pocket, and that gives you far more functionality than needed.



Wireless webcam and netbook

Sensors Wifi, can be hacked to include GPS (with antenna), Bluetooth, internal card reader, additional internal flash drive, 802.11N, FM transmitter and modem

Cute, but where does the AV cable go ?



Tie Hidden Camera

By Brickhouse security

Cost \$199.95

Sensors No other sensors

Image quality NTSC, 350 Resolution TV
Lines

Video? 30fps

Capacity AV cable out

Again .. The AV camera ? It's a capture device, not a capture and store device



Homemade spy camera glasses

By Self-assembled
Cost depends on equipment, as little as \$40
Sensors No other sensors

SenseCam / Vicon Revue

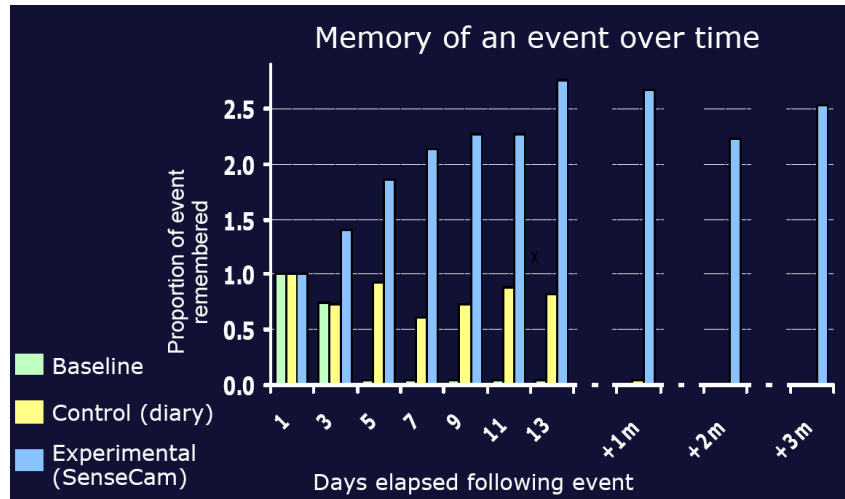
Oct 2009 Microsoft announced licensing SenseCam technology to Vicon, motion capture company from Oxford, UK.

Vicon will initially manufacture MSR SC 'clones' which retail at c.£500 each - associated software is the MSR viewer, but point to DCU event -based browser. Expect to start shipping 2010Q1

Vicon engaging clients and customers on what other sensors should be in ViconRevue-2 ... GPS, compass, better quality images ..

Expect hands-on practice with prototype in 2010Q1

Why SenseCam?



NEWSFOCUS

NEUROSCIENCE

A Memorable Device

Wearable cameras offer help to people with memory problems and provide a tool for studying how the brain creates and retrieves personal histories.

It was over drinks at a local pub in the spring of 2006 that cognitive psychologist Martin Conway of the University of Leeds in the United Kingdom first told his colleague Chris Moulin about using a wearable camera for memory research. But it took more than a few pints of beer to convince Moulin that SenseCam, a camera that periodically takes still photos while worn on the user's chest, might be a game-changer in the study of what psychologists call autobiographical memory. Although skeptical of the small device's usefulness, Moulin did finally agree to take one for a test drive.

Of course, he took it on a test walk. Moulin regularly wore a SenseCam on a series of walks. When he reviewed the images 6 months later, to see how well his memories matched the camera's visual record, Moulin says he experienced an unexpected feeling of "mental time travel." One of the images triggered the memory of the song—"Tom Yorke's 'Black Swan'—that was playing on his iPod when the image was taken.

Conway says that many SenseCam users describe seeing a sudden flood of memories of thoughts and sensations, what he calls "Present moment memories." When they review images taken by the device, SenseCam's images "correspond to the nature of human memory—they're fragmentary, they're formed outside your conscious control, they're visual in nature, they're from your perspective. All these features are very like what we call episodic memory," says Conway.

That's why he, Moulin, and dozens of other researchers have begun to test whether the images can help resolve how the brain handles personal memories. Conway says the images, however, represent just one line of inquiry supported by Microsoft Research, the scientific arm of the software giant and the inventor of SenseCam. Medical researchers are also evaluating whether the device can help people with memory problems due to illness or injuries.

In 2004, Narinder Kapur and Emma Berry, neuropsychologists at Addenbrooke's Hospital in Cambridge, were the first to use a SenseCam for memory rehabilitation work. They found that it was particularly helpful for Mrs. B, an elderly woman with memory problems due to brain damage from an infection. Mrs. B normally forgot

events after 3 to 5 days, and even keeping a diary that she periodically reviewed helped her remember events for only about 2 weeks. But when she regularly reviewed images of events, she could recall more details—and her memories persisted for months after she ceased reviewing the most images. Encouraged by that data, Kapur says he and Berry grew hopeful that "periodic, regular review of visual images of personal events ... really does help long-term [memory] consolidation."

In an accident, says Ken Wood of Microsoft Research Cambridge. In 1999, computer scientist Lynsey Williams then died at the same lab, suggested adding a camera to the device so it could double as a memory aid for mundane tasks such as finding lost keys.

In 2002, Kapur heard that Microsoft CEO Bill Gates mentioned the project in a talk. Because his hospital is just a few miles from Microsoft Research Cambridge, it was easy enough for him and Berry to suggest using SenseCam prototypes for patients with memory problems due to Alzheimer's, or brain injuries.

Doctors who work with such people have typically focused on helping them with their prospective memory, i.e., remembering tasks to be completed in the future, such as keeping appointments. For this, the best aids are still simple tools such as checklists and alarm clocks. But for patients with difficulty recalling past events, clinicians have had little to offer beyond diary-keeping, a task many people, such as Mrs. B and her husband, complain is onerous.

In contrast, SenseCam records images passively, permitting a person to go about their day without interruption. The latest version is about the size and weight of a chunky mobile phone and appears to observe the scene through two simulated eyeballs. One is a passive infrared sensor, tuned to trigger the camera whenever another person passes by. The other is a wide-angle camera lens, set to capture most of the user's field of view. The device is also equipped with an ambient light sensor that triggers the camera when its user moves from one room to another, or goes in or out of doors. The camera can also be set to snap an image if the sensors haven't triggered a photo after an arbitrary number of seconds. A typical wearer might come home with 2000 to 3000 fragments, or at least images at the end of a day.

It may be just these characteristics of the SenseCam images that make them so useful for memory rehabilitation and research, Kapur

Shooting in the rain. The SenseCam (left) snaps dozens of wide-angle, low-resolution images from their level on seen a short walk.

They and others are getting a chance to test that hypothesis. After the pair reported the results from Mrs. B, Microsoft Research decided to provide more than \$550,000 in funding to seven research groups, most of them focusing on people with memory problems, and so some hundreds of cameras to other scientists. SenseCam has "very obvious applications in a whole range of clinical disorders," says one of the grant recipients, psychologist Philip Barrow of the University of Cambridge.

Personal black boxes
SenseCam is part of a Microsoft Research project that aimed to create a "black box for the human body," which would record data that doctors might find useful if a person were

Downloaded from www.sciencemag.org on November 20, 2009

1422 13 MARCH 2009 VOL 323 SCIENCE www.sciencemag.org Published by AAAS



Print | Close this window

RPT-UPDATE 1-Microsoft camera deal powers OMG share jump

Thu Oct 15, 2009 10:16am EDT

(Refills to add missing word, paragraph 4)

- * OMG signed a licence with Microsoft
- * Camera to help people with Alzheimer's Disease
- * Shares up more than 26 pct, a top riser on AIM

(Adds details)

LONDON, Oct 15 (Reuters) - British firm OMG (OMG1.L: Quote, Profile, Research, Stock Buzz) announced it had received licensing from Microsoft (MSFT.O: Quote, Profile, Research, Stock Buzz) to launch a small digital camera aimed at helping people with memory loss, boosting its shares on Thursday.

Called Revue, the camera is intended to be worn around a person's neck, recording everything they do and serving as a memory aid for people with Alzheimer's Disease.

"Memory is very visually indexed... and this device is really just trying to help an

TIME
SEARCH.TIME.COM

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Health & Science
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Advances for Alzheimer's, Outside the Lab

By EBEN HARRELL Monday, Feb. 23, 2009

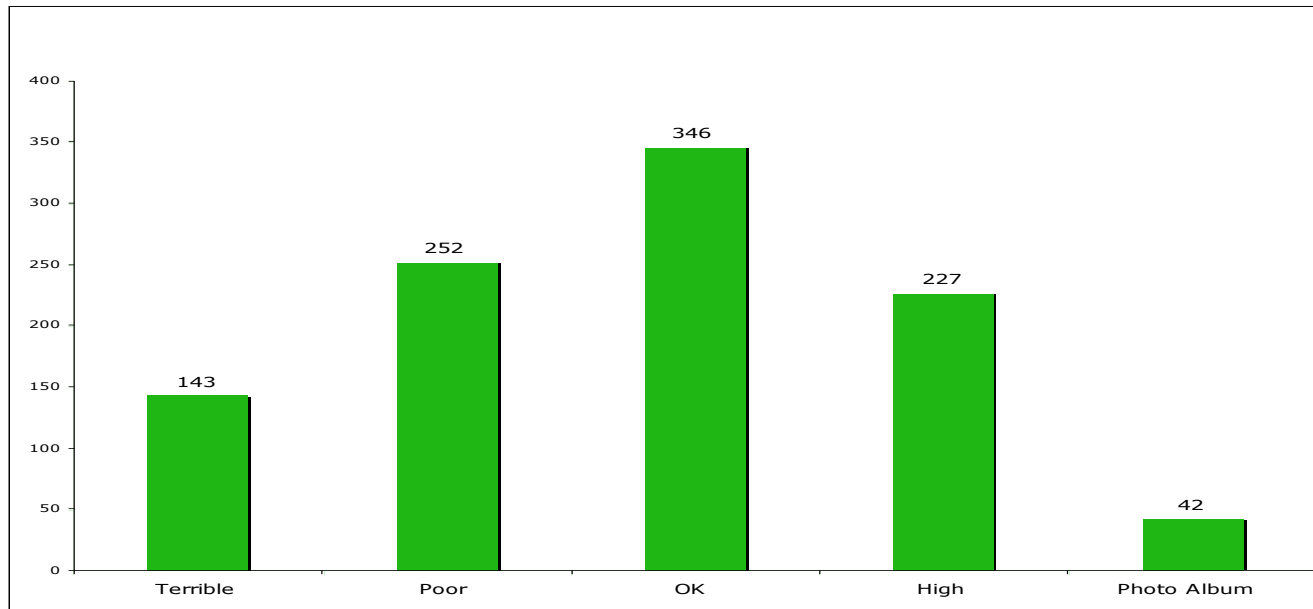
Fancy / Veer / Corbis

They sit demurely in rows of plastic chairs, hands in their laps, awaiting instructions. They have been dressed carefully by their spouses and relatives in ankle-long frocks or neat cardigans, with crisply knotted ties — the overly formal style of the aged.

Related Organizing this unlikely choir is



SC Image Quality



- 40% of images are of low quality
- Many “boring” images of mundane tasks

Over last 5 years we’ve developed techniques for SenseCam data management, without having user input or direction ...

... we’ve now developed this into MM data management, leveraging it for several other applications

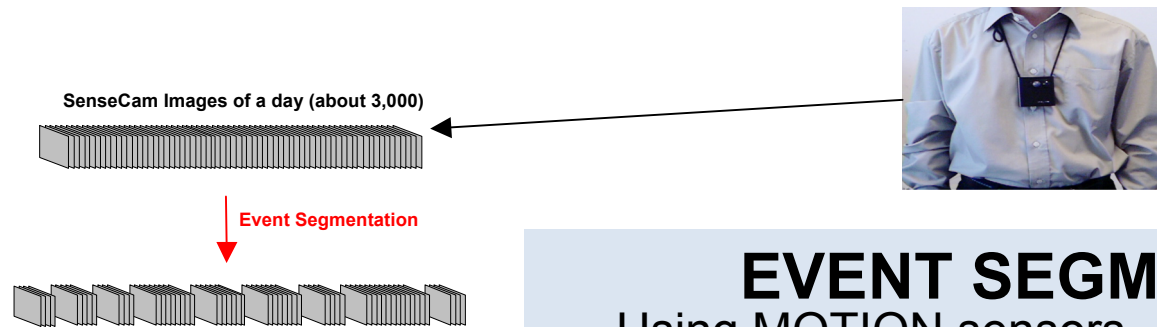
Our Take...

Purpose of managing a visual lifelog is to take people to images which trigger recall

To effectively provide memory retrieval cues using SenseCam we need to automatically:

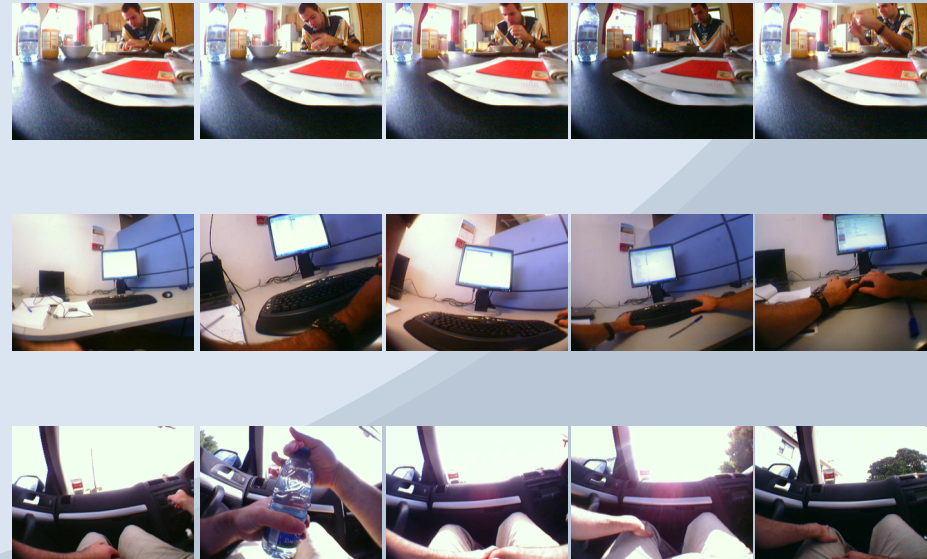
- *Group similar images into distinct “events”*
- *Suggest more “interesting/distinctive” events*
- *“Associate” related events*
- *Provide potentially additional retrieval cues from other sources*

Daily Browser Overview

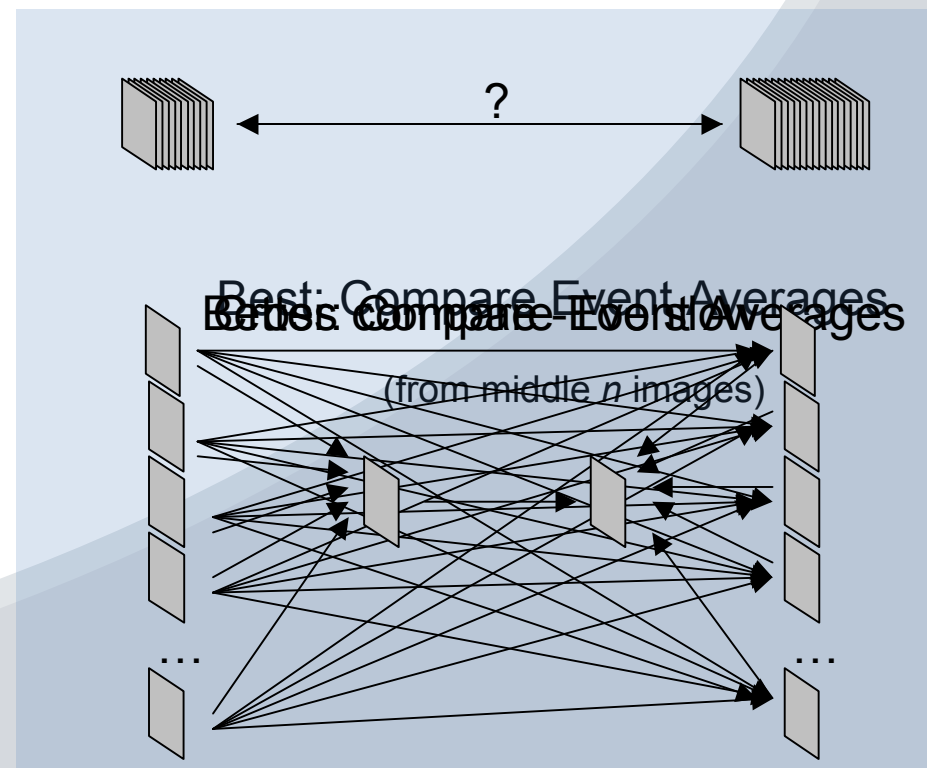
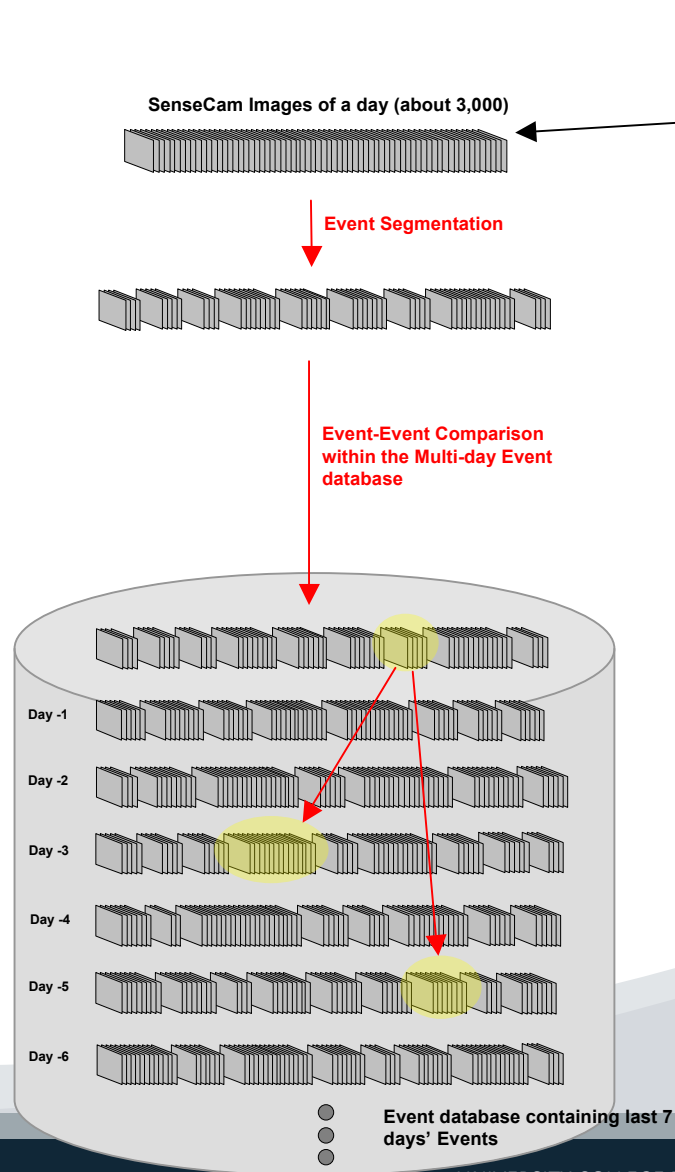


EVENT SEGMENTATION

Using MOTION sensors – very quick & accurate



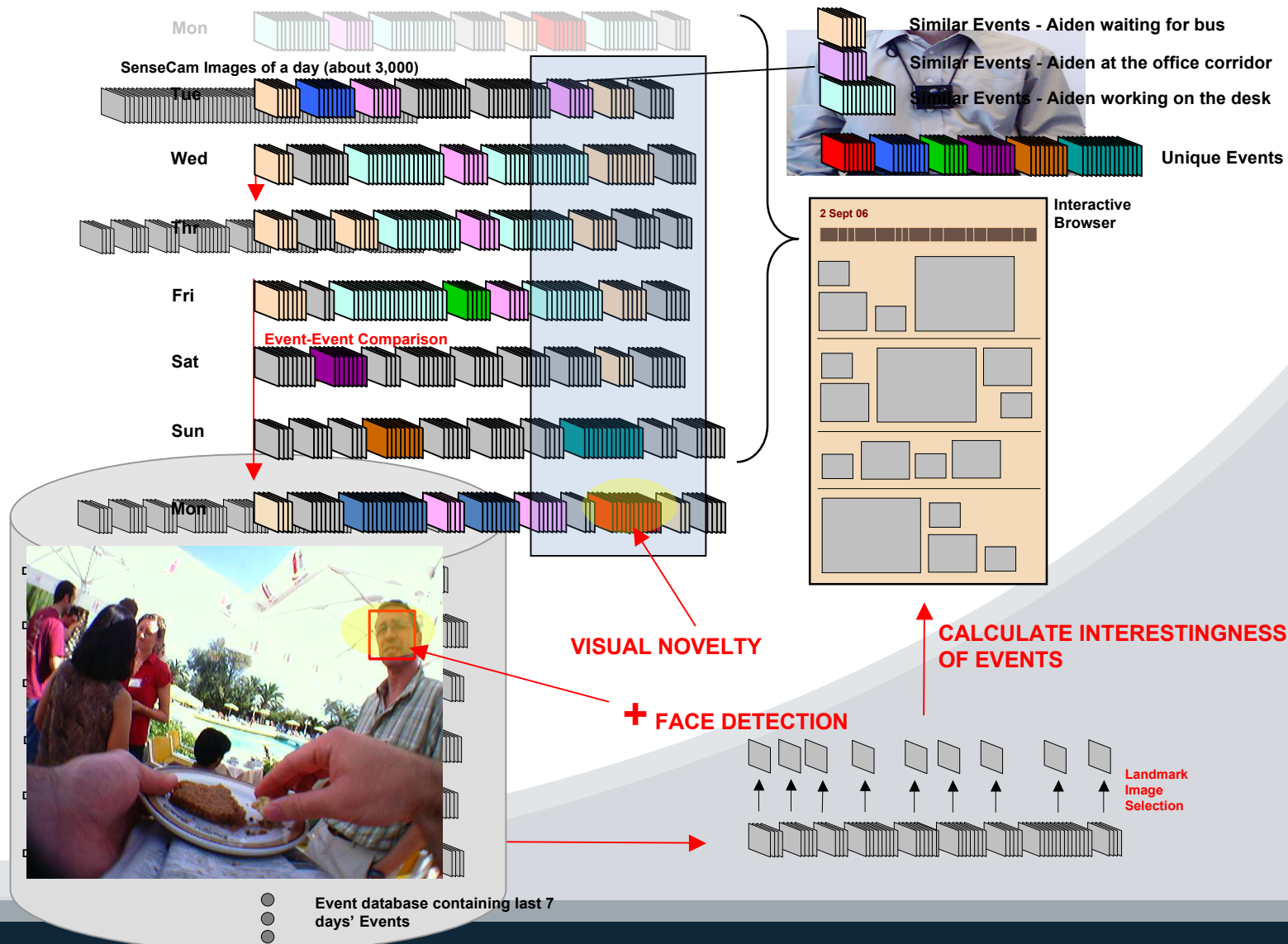
Visual Search Facilities



Selecting Event “Keyframe”



Suggest Interesting Events



Event augmentation

Here's a SenseCam picture of Aiden at a pier in Santa Barbara, CA.

If he has GPS he can search for other pictures in the same location...



Event augmentation – more cues

- He receives the following “geotagged” images...
- Then after some processing on text associated with these images we get many more images, and even YouTube videos at times too!



Event Augmentation

Does it work?

Yes – we have it operational from 6 image sources, tested and evaluated with users.

Bringing the threads together ... event segmentation, keyframe selection, event importance, event searching, and event augmentation ...

... we have a system to manage a lifelog



CALENDAR

◀ MAY ▶ 2006 ▶

S M T W T F S

30 1 2 3 4 5 6

7 8 9 10 11 12 13

14 15 16 17 18 19 20

21 22 23 24 25 26 27

28 29 30 31 1 2 3

4 5 6 7 8 9 10

DURATION ▶

CAPTION SEARCH

WEEKLY SUMMARY

Selected day is shown below in the context of whole week. Move mouse cursor over to see other similar Events in the week

S

M

T

W

T

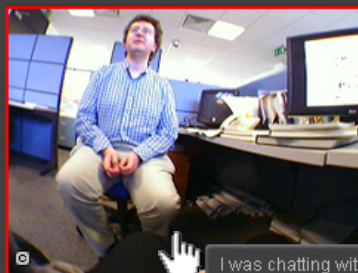
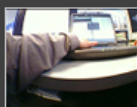
F

S

29 May 2006

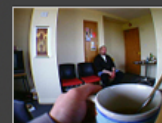
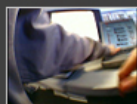
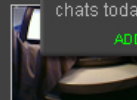
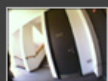
19
EVENTS

Drag the slider bar to adjust the number of Important Events



I was chatting with Gareth on the conference in July. Quite a few chats today! ☺

[ADD TO FAVE](#) | [FIND SIMILAR](#)



MY ACCOUNT | SIGN OUT | ABOUT

My Favourite Events ¹

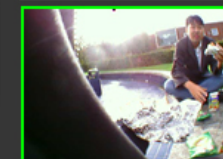
25 Favourite Events are shown below. Click on the photo to replay all photos within the Event.

| 1 | 2 | 3 |

Sort by: **TIME** | SIMILARITY | #PEOPLE



16:20 (Duration: 08m 43s)
14 APR 2006 ▶



13:45 (Duration: 14m 05s)
14 APR 2006 ▶



10:02 (Duration: 23m 56s)
13 APR 2006 ▶



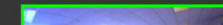
14:39 (Duration: 15m 30s)
12 APR 2006 ▶



11:25 (Duration: 06m 21s)
12 APR 2006 ▶



09:52 (Duration: 01m 03s)
12 APR 2006 ▶



1

Released CLARITY Browser

 SENSECAM VIEWER

Close

Friday
09 October 2009

1541 Photos (13:34 - 18:48)

You can touch one of the events below to view the photos within it.

Show Calendar

Touch the button above to view different days

Add

Help

13:34 pm

13:39 pm

13:44 pm

14:02 pm

15:31 pm

15:36 pm

16:21 pm

16:25 pm

Event Segmentation S/W

- Carnegie Mellon University
- CWI, Amsterdam
- Lulea University of Technology
- Olivier Zangwell Centre
- “Mrs. W.”
- University of Leeds
- University of Limerick
- University of Toronto
- University of Utrecht
- + 9x users in DCU
- Sussex partnership NHS trust
- University of Oxford
- Halvar Jonson Centre for Brain Injury, Canada
- Uni of California, San Diego
- Hochschule Furtwangen
- Utrecht University
- Twente University
- University of Tampere
- University of Illinois

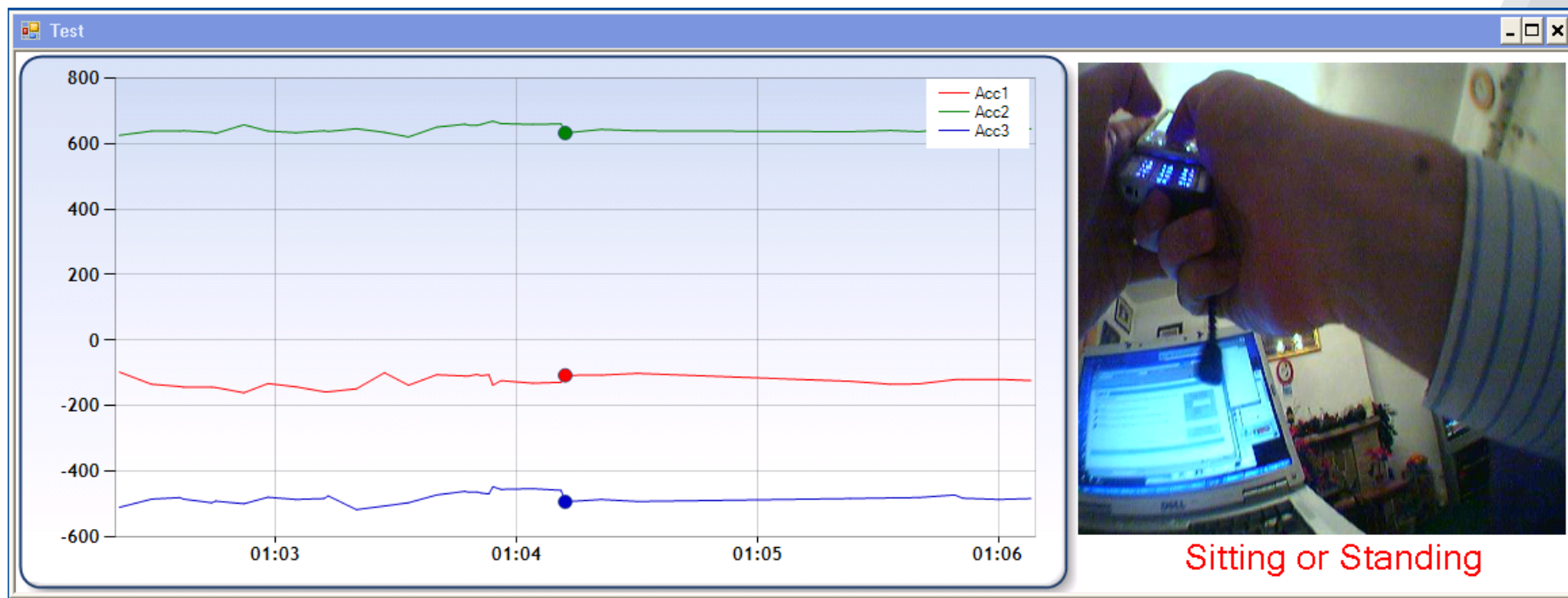
Overview

- What is lifelogging and why bother
- Visual lifelogging, devices and SenseCam
- Our work on SC data management, events, event browsing and augmentation
- Further uses for lifelogging data
 - Activity Recognition
 - Diet Monitoring
 - Scene Detection
 - Trajectory Estimation
 - Incorporating Contextual Information
 - CO₂ Estimation
- Lifelogging - where next ?

Identifying Activities using accel.

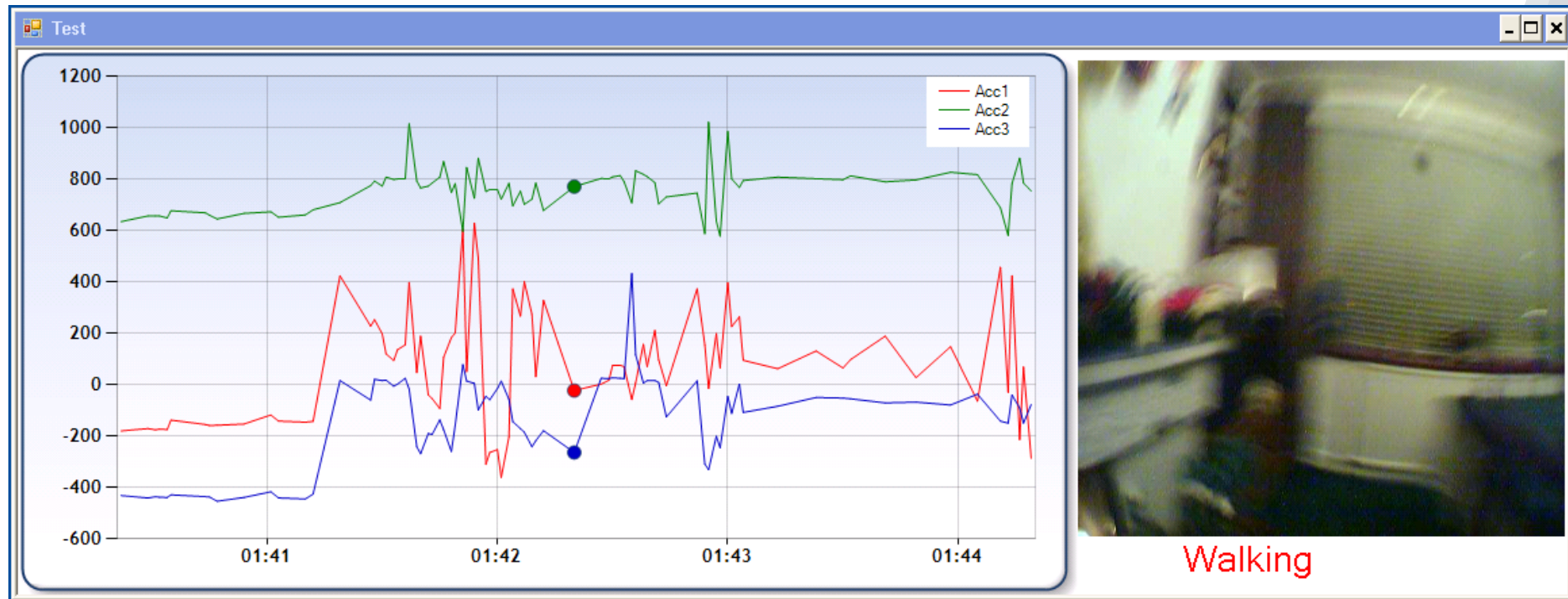
Sitting/Standing = 75% accurate

Using a range of classifiers: Logistic Regression, Naïve Bayes, J48, SVM, etc.



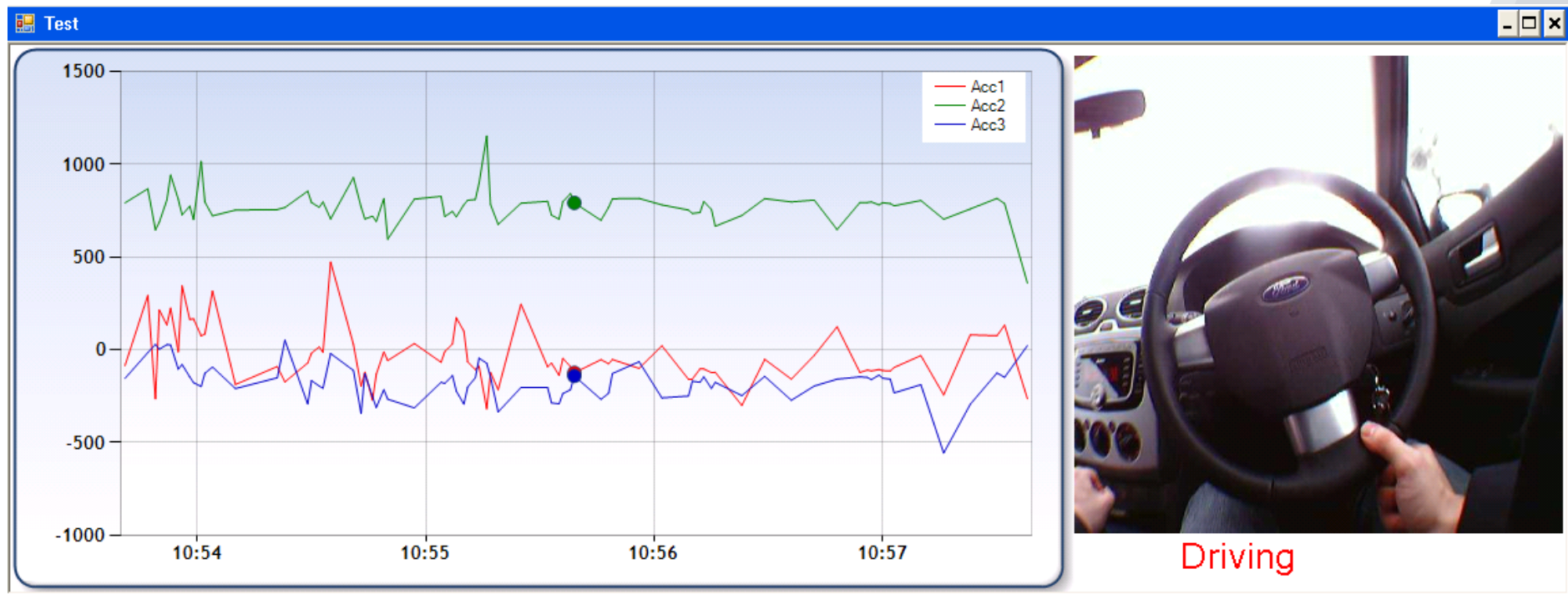
Identifying Activities using accel.

Walking = 77% Accurate



Identifying Activities using accel.

Driving = 88% Accurate

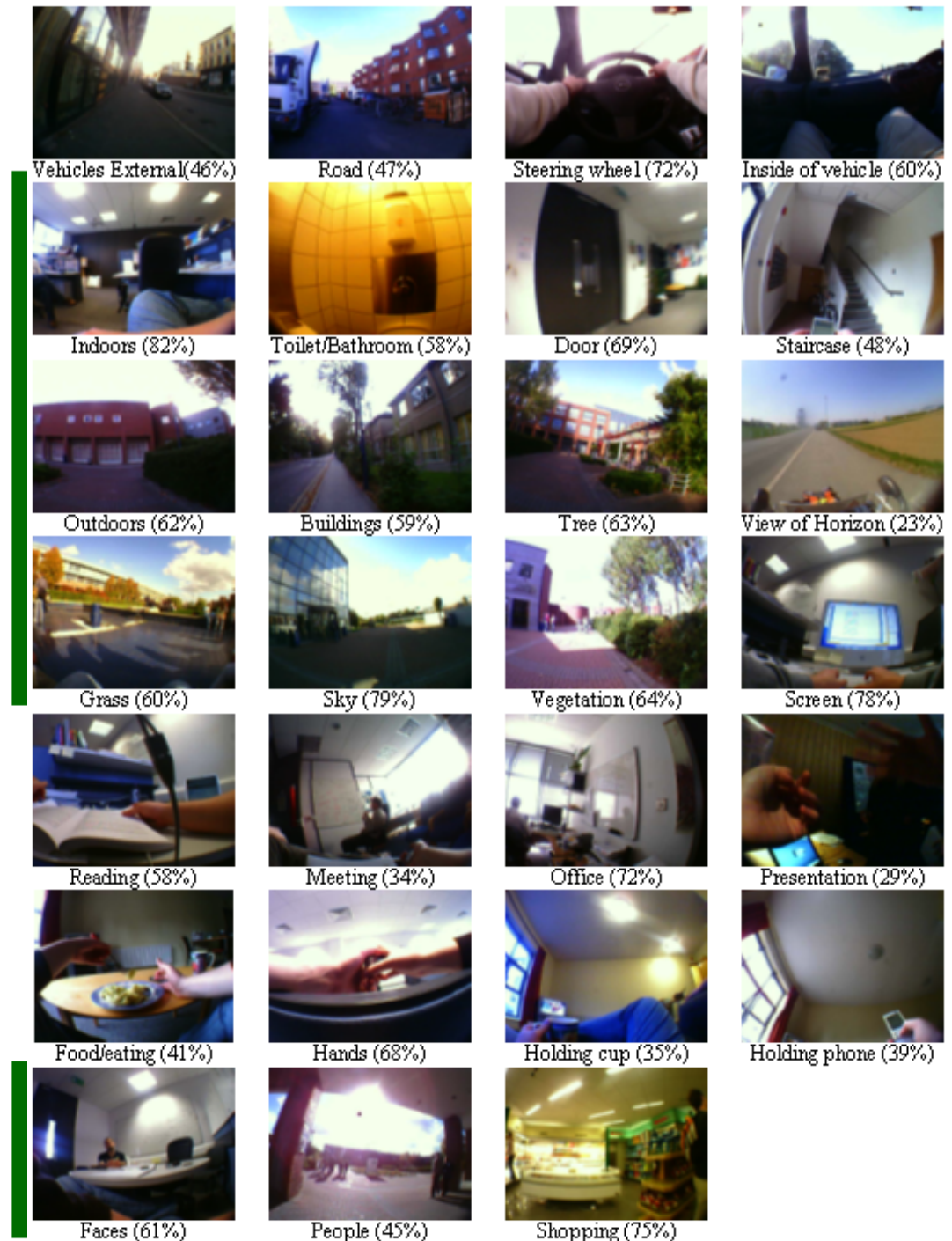


CLARITY SenseCam Work

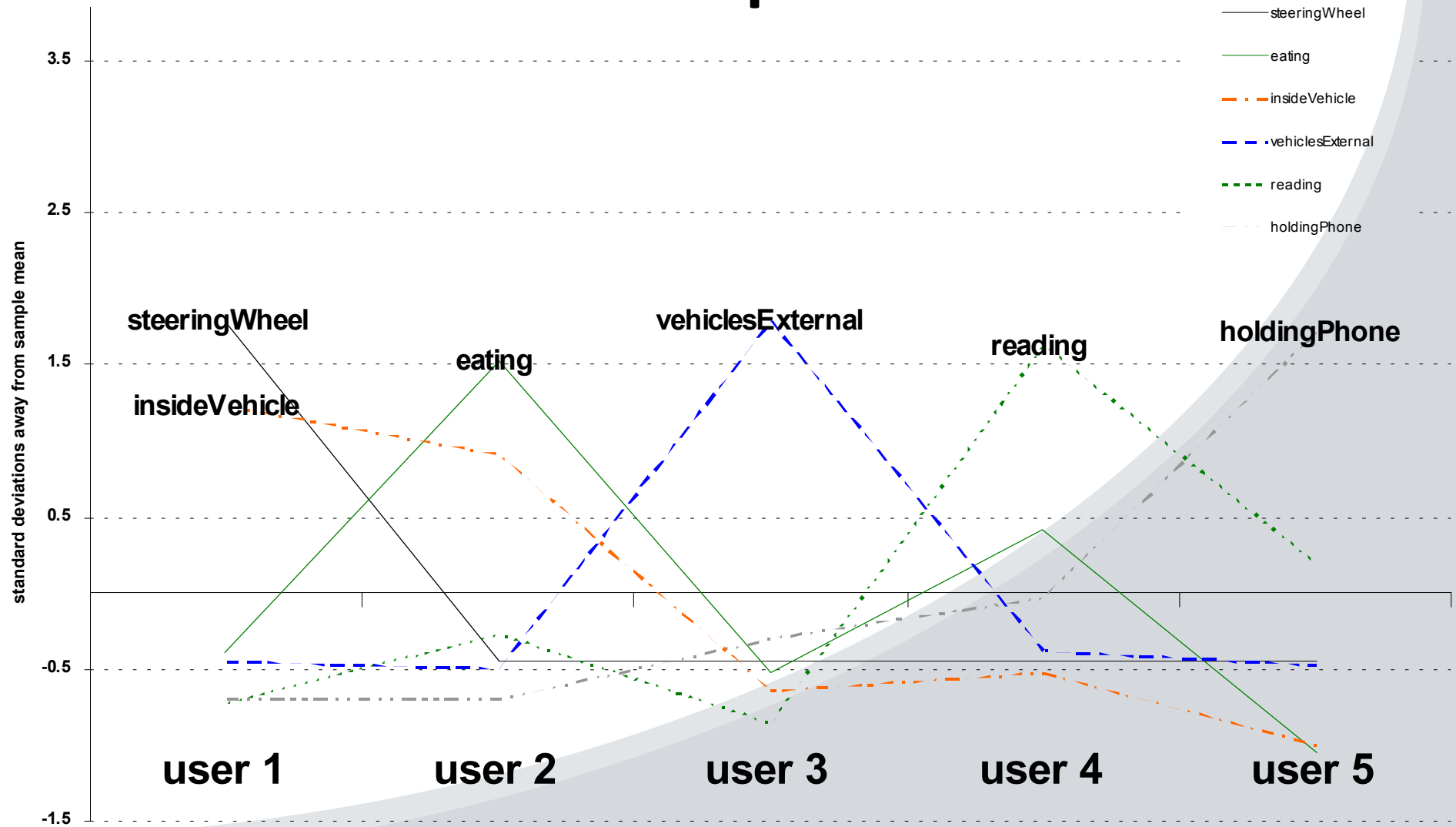
Activity Recognition *using Images*

27 “concepts”

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



Comparison of Lifestyle Within Social Groups



Use Case: Dietary habits

Consider using even only the “Eating” concept...

- Detect events where user is eating - visual and accelerometer
- Allows us/family/dietitians gain more complete record of our eating habits

Choose a day in the calendar or
[Click to get some advice!](#)



Fats, Oils, & Sweets
Use Sparingly

Milk, Yogurt & Cheese Group
2-3 Servings

Meat, Poultry, Fish, Dry Beans, Eggs, & Nuts Group
2-3 Servings

Vegetable Group
3-5 Servings

Fruit Group
2-4 Servings

Bread, Cereal, Rice, & Pasta Group
6-11 Servings

Choose a day in the calendar to get some advice!

junio de 2006						
lun	mar	mié	jue	vie	sáb	dom
29	30	31	1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	1	2
3	4	5	6	7	8	9

You should not eat that much sweets, fats and oils. Use them sparingly!
Next time try to take less meat, fish, eggs or products in this group.
Don't forget a bigger amount of vegetables next time!



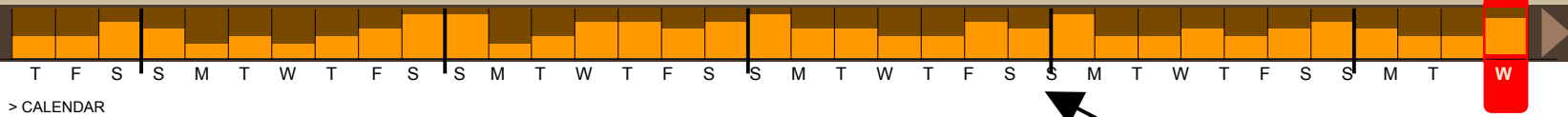
Breakfast: Milk is important for our bones, you started your day with a perfect amount of milk!!
You can take as cereals and bread as you want, and they are perfect at breakfast!!
Fruit and vegetables are good for your health. You introduced it in your breakfast, well done!!
Come on!! leave the sweets and food from meat group for lunch, or for dinner!!
Lunch: Remember that you can always have some milk derived product as dessert!
Lunch with bread...perfect!!
Great amount of fruit for lunch!!
You can introduce some vegetables in your lunch!!
Meat, fish and eggs. Proteins for your body, good lunch amount!
Afternoon snack: Remember: afternoon snack has to be light. Try with a piece of fruit and some honey.
Dinner: Milk is important for our bones, you can take some milk derived product for dinner!!
Dinner with bread...perfect!!





MY DIET RECORD

Cathal | HELP | ABOUT



WEDNESDAY 17 OCT 2008

This day's food intake is as following:

4 Meals

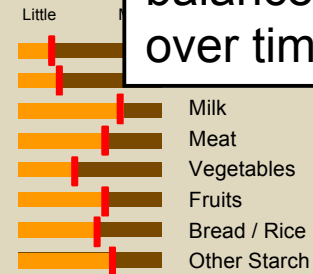
2,118 Calories

Select a meal to annotate and/or see the type of food eaten for that meal

Detected 'eating' events listed, for the

This re-calculates the overall calorie-exercise balance and displays on the screen

Meal 1 10:47am



My total calorie balance for each day over time...

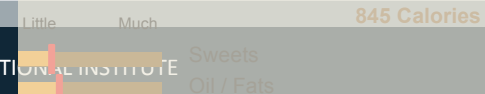
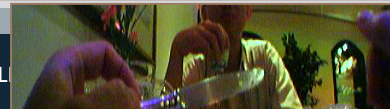
Meal 2 1:20pm



Meal 3 3:15pm



Meal 4 8:08pm



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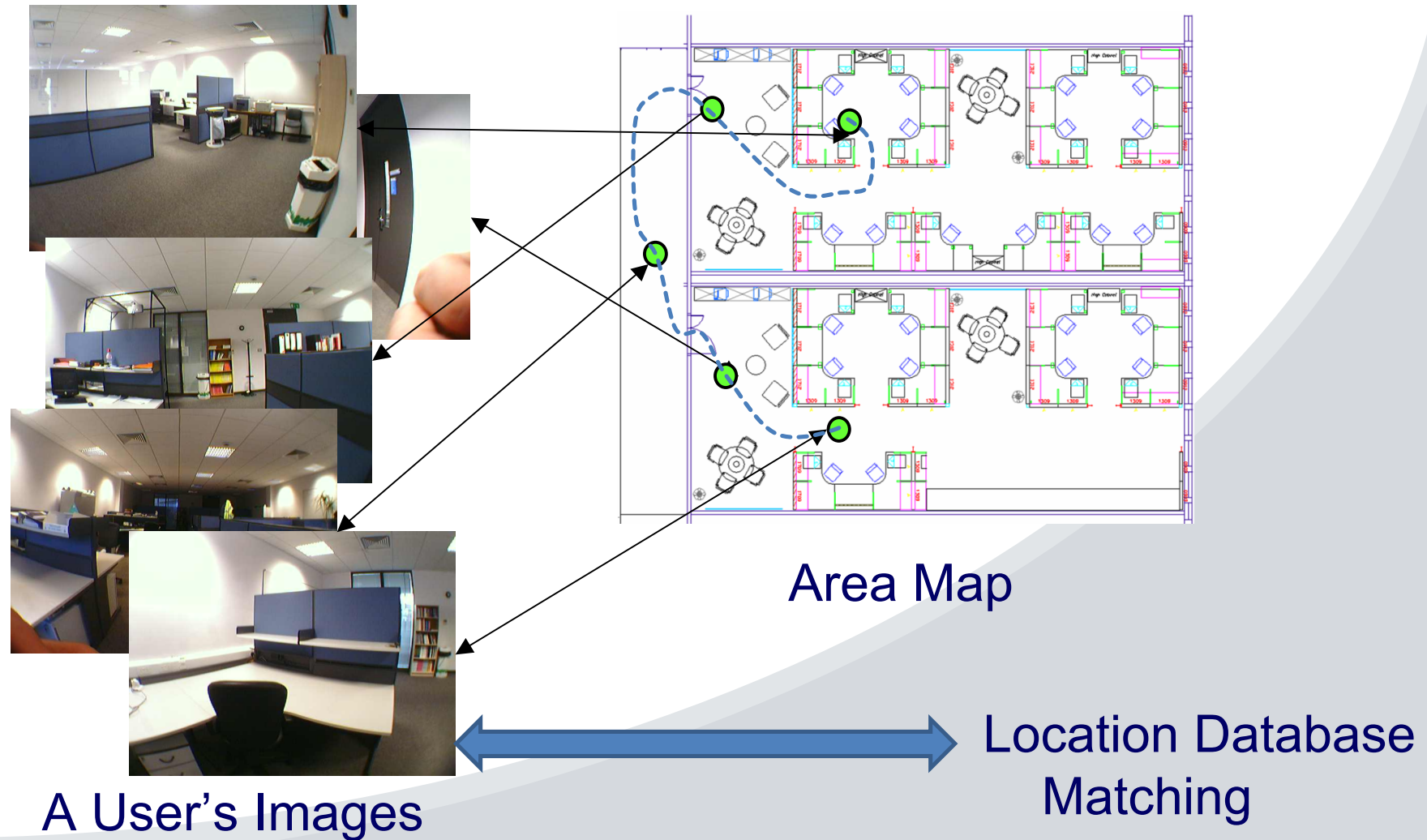
Setting Detection – Watching TV



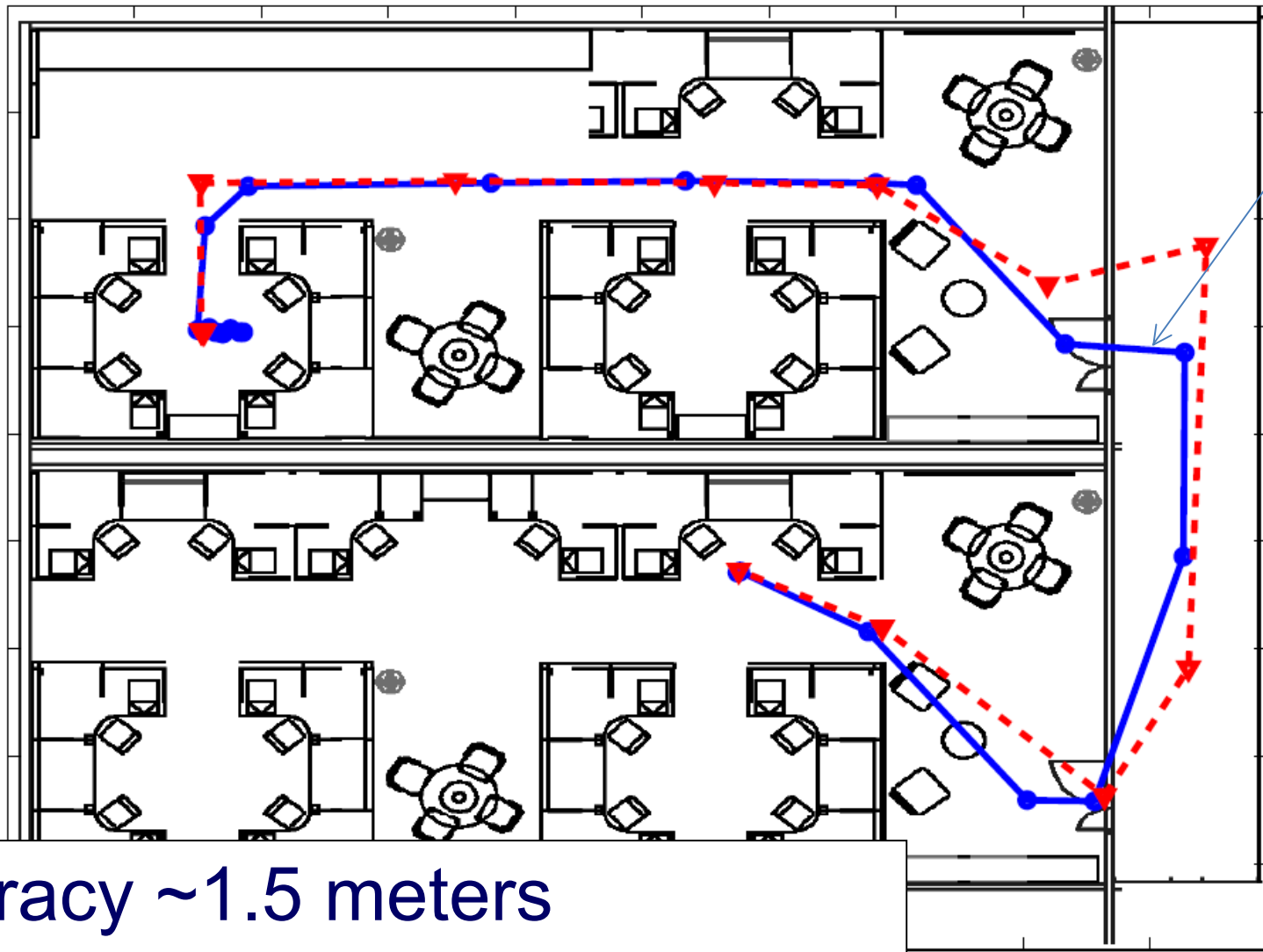
Setting Detection – In the Park



Trajectory Estimation



Trajectory Estimation Results



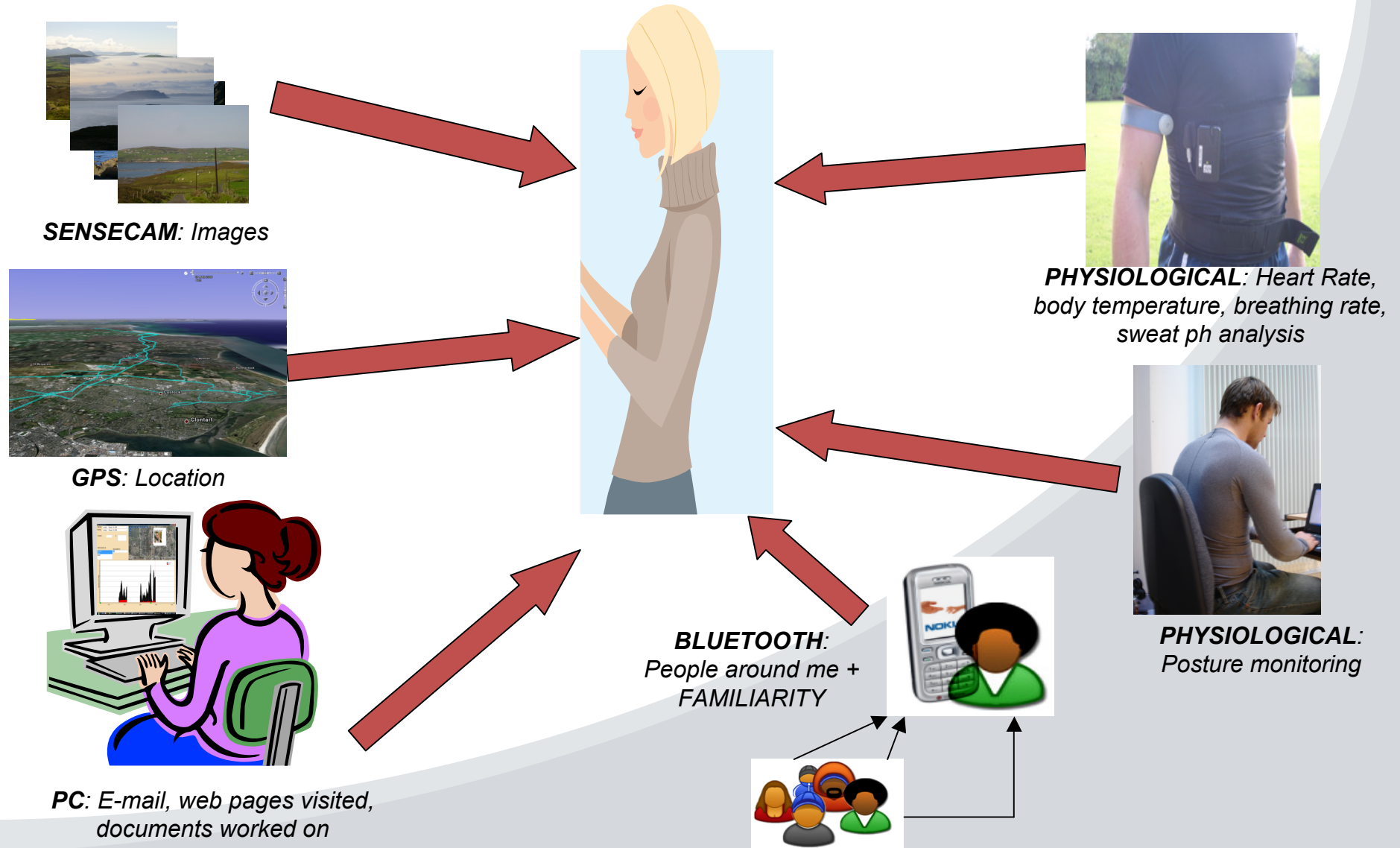
Accuracy ~1.5 meters

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SC + Other Data Sources ?



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CO₂ Estimation

Here's a green application - estimating CO₂

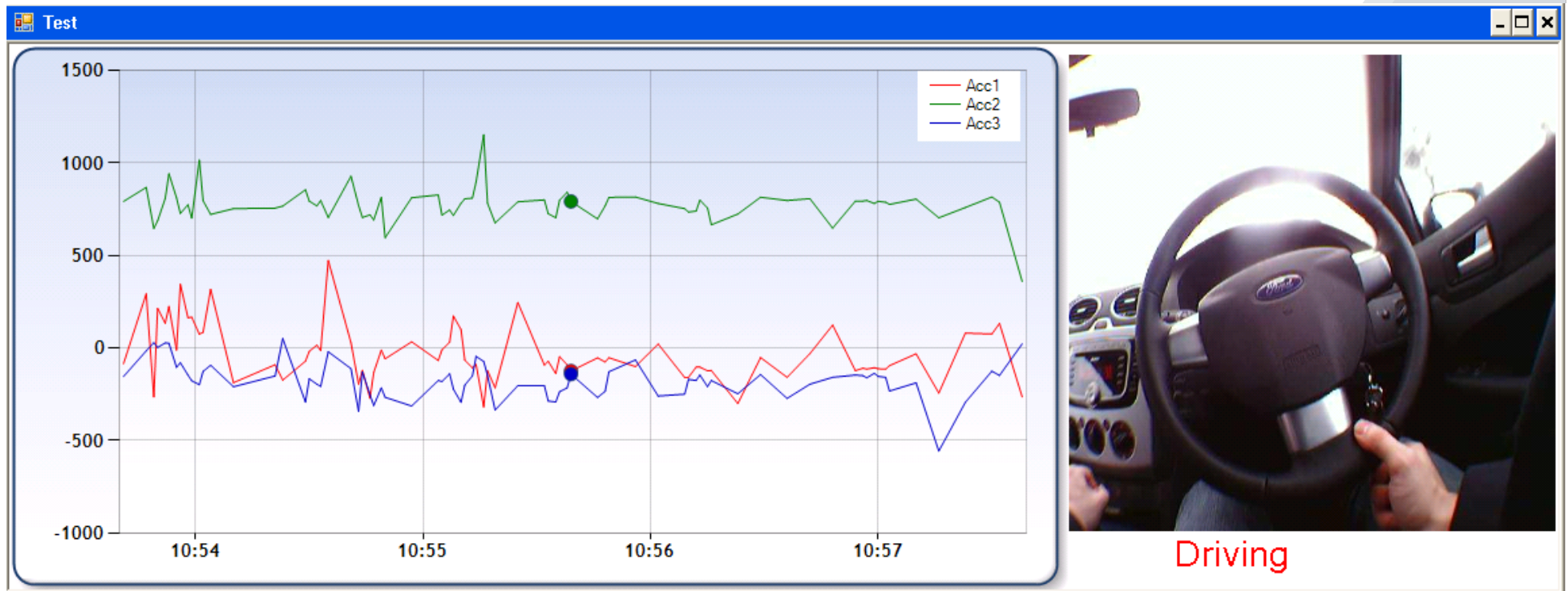
In Ireland, 36% personal CO₂ emissions are transport-related, 31% are electricity, 33% are heat

Can we use lifelogging devices to estimate our Carbon emissions - important to raise awareness, Carbon taxes, etc.

Classifying Activities

Driving = 88% Accurate

Using a range of classifiers: Logistic Regression, Naïve Bayes, J48, SVM, Etc.



More complete CO₂ Estimation

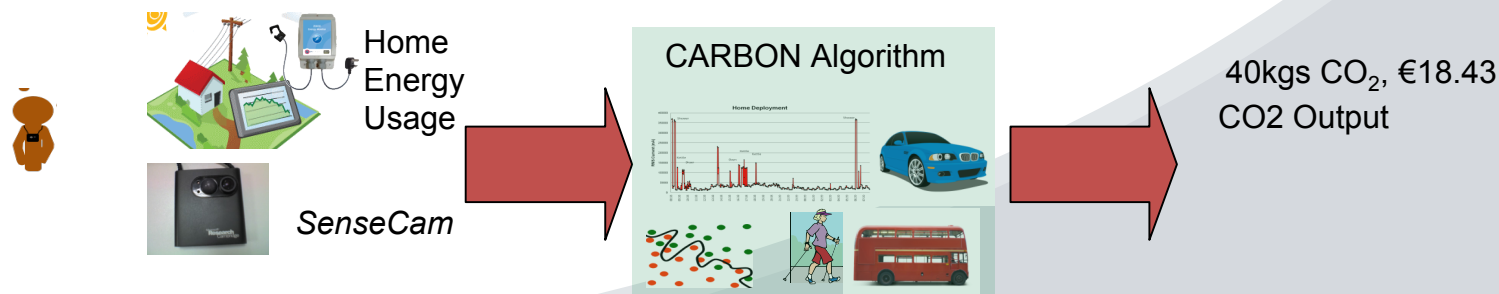
2 simple sensors

Domestic power logger
Wearable accelerometer

Use Case

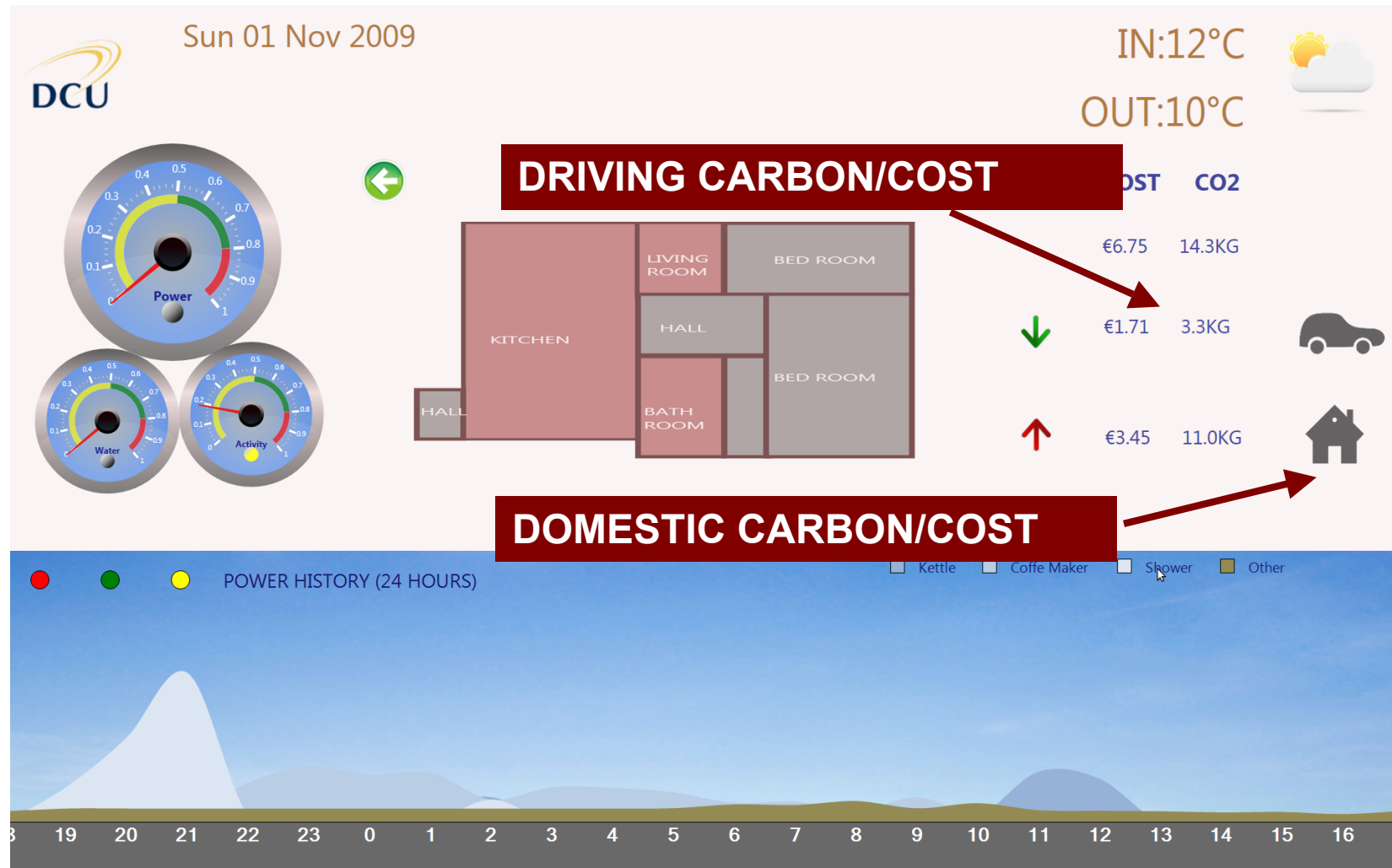
1 user: power logger + SenseCam

2 months: 963,000 domestic power readings + 3,020,900
SenseCam acc readings



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ONLINE VERSION**

Complete CO₂ Picture on TV



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- Lifelogging - where next ?

So what was Multimedia

.. and why is lifelogging a new challenge ?

We used to believe that multimedia = {image, audio, video}, maybe with 3D, text was poor multimedia

Then we started tagging and mashing and creating UGC and volume increased and there's the challenge

Lifelogging is based on just a few sensors ... accelerometer, energy, maybe a camera ... and it leverages into such useful information ... useful because it is personal, it is me, you

Because it is personal, and it is now, this is information that matters, to me.

From raw and noisy signals is extracted meaningful and useful information

It can be events, encounters, social interactions, people, activities, and it can be at multiple hierarchical levels

The challenge is managing, delivering, filtering, etc.